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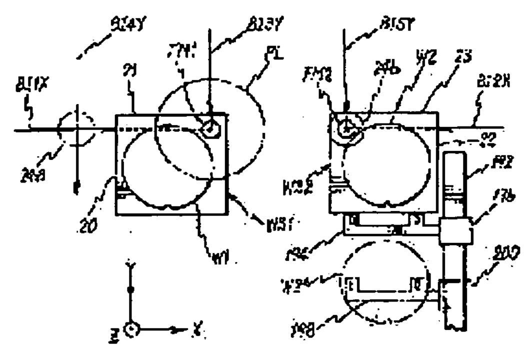
(54) DEVICE AND METHOD FOR PROJECTION ALIGNMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To improve the throughput of a projection aligner and to reduce the size and weight of a substrate stage.



SOLUTION: The operations of two stages WS1 and WS2 are controlled, so that the positional relation between the alignment mark of a substrate W2 and a reference plate FM2 on the stage WS2 may be detected accurately by using the detected results of an alignment system 24b and measured values on a length measuring axis BI5Y, while the substrate W1 is exposed through a projection optical system PL by controlling the position of the stage WS1 by using measured values on length measuring axes BI1X and BI3Y. When the operations of both stages WS1 and WS2 are terminated, in addition, the interferometer on the axis BI3Y is reset in a state where the position of the stage WS2 can be measured by using the measured values on the axis BI3Y and, at the same time, the operations of the stage WS2 are controlled so that the reference plate FM2 can be positioned to a position, where the positional relation between the interferometer and a prescribed reference point (projecting center of the image of a mask pattern) in the projection area of the projection optical system can be detected.

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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] It is the projection aligner which carries out projection exposure of the image of the pattern formed in the mask on an induction substrate through projection optics. Said projection optics is established independently. an induction substrate -- holding -- the inside of a two-dimensional flat surface -- the movable 1st substrate stage and; induction substrate -- holding -- the inside of the same flat surface as said 1st substrate stage -- said 1st substrate stage -- the independently movable 2nd substrate stage and; -- The alignment system for detecting the mark on the induction substrate held on said substrate stage or on said substrate stage; the location of said 1st shaft orientations of said 1st substrate stage from the one side of the 1st shaft orientations passing through the projection core of said projection optics, and the detection core of said alignment system The always measured 1st length measurement shaft and the 2nd length measurement shaft which always measures the location of said 1st shaft orientations of said 2nd substrate stage from the other side of said 1st shaft orientations, The 3rd length measurement shaft which intersects said 1st shaft and perpendicular focusing on projection of said projection optics, It has the 4th length measurement shaft which intersects said 1st shaft and perpendicular focusing on detection of said alignment system. With these length measurement shafts The two-dimensional location of said 1st and 2nd substrate stage Interferometer systems measured, respectively; while the induction substrate which the location of one stage of said 1st substrate stage and the 2nd substrate stages was managed using the measurement value of said 3rd length measurement shaft of said interferometer systems, and was held on one [this] stage is exposed The physical relationship of the alignment mark on the induction substrate held on the stage of another side of said 1st substrate stage and the 2nd substrate stages and the reference point on the stage of said another side the detection result of said alignment system, and the measurement value of the 4th length measurement shaft of said interferometer systems After controlling actuation of said two substrate stages to be used and detected, while using the measurement value of said 3rd length measurement shaft and resetting the interferometer of said 3rd length measurement shaft in the condition in which location measurement of the stage of said another side is possible The control means which controls actuation of the stage of said another side so that the origin/datum on the stage of said another side is positioned in the location which can detect physical relationship with the predetermined origin/datum in the projection field of said projection optics, and the projection aligner which has;.
[Claim 2] It has another alignment system which has a detection core on said 1st shaft in the opposite side of said alignment system about said projection optics. Said interferometer systems It has the 5th length measurement shaft which intersects said 1st shaft and perpendicular focusing on detection of said another alignment system. Said control means While the induction substrate which the location of one [said] stage was managed using the measurement value of said 3rd length measurement shaft of said interferometer systems, and was held on one [this] stage is exposed After controlling actuation of said two substrate stages so that the physical relationship of the alignment mark on the induction substrate held on the stage of said another side and the reference point on the stage of said another side is detected using the detection result of said alignment system, and the measurement value of the 4th length measurement shaft of said interferometer systems While resetting the interferometer of said 5th length measurement shaft in the condition in which location measurement of one [said] stage is possible using the measurement value of said 5th length measurement shaft

The projection aligner according to claim 1 characterized by controlling actuation of one [said] stage so that the origin/datum on one [said] substrate stage is positioned in the detection field of said another alignment system.
[Claim 3] It is the projection aligner according to claim 2 which has further the carrier system which delivers an induction substrate between said 1st substrate stage and said 2nd substrate stage, and said control means is in the condition which positioned the origin/datum on one [said] substrate stage in the detection field of said another alignment system, and is characterized by delivering a substrate between one [said] stage and said carrier system.
[Claim 4] It is the projection aligner according to claim 1 which the reference mark as a reference point of said stage is formed on said 1st substrate stage and said 2nd substrate stage, respectively, and is characterized by to have further a mark location detection means the predetermined reference point in the projection field of said projection optics is based on projection of the pattern image of said mask, and detect the relative-position relation between the projection core of the pattern image of said mask, and the reference mark on said stage through said mask and said projection optics.
[Claim 5] It is the projection exposure approach which carries out projection exposure of the image of the pattern of a mask on an induction substrate through projection optics. While an induction substrate is held, two independently movable substrate stages are respectively prepared for the inside of the same flat surface and a predetermined interferometer performs one location measurement of said two stages Projection exposure of the pattern image of said mask is carried out on the induction substrate held on one [this] stage. While an interferometer other than said predetermined interferometer performs location measurement of the stage of another side of said two stages during exposure of the substrate held on one [said] stage The physical relationship of the alignment mark on the substrate held on the stage of this another side and the reference point on the stage of said another side is measured. While resetting said predetermined interferometer with said predetermined interferometer after exposure termination of the substrate held on one [said] stage in the condition in which location measurement of the stage of said another side is possible The origin/datum of the stage of said another side is positioned in the location which can detect physical relationship with the predetermined origin/datum in the projection field of said projection optics. The projection exposure approach characterized by performing alignment of the induction substrate and the pattern image of a mask which were held on the stage of said another side using said reset predetermined interferometer based on said measured physical relationship.
[Claim 6] It is the projection aligner which carries out projection exposure of the image of the pattern formed in the mask on an induction substrate through projection optics. Said projection optics is established independently. an induction substrate -- holding -- the inside of a two-dimensional flat surface -- the movable 1st substrate stage and; induction substrate -- holding -- the inside of the same flat surface as said 1st substrate stage -- said 1st substrate stage -- the independently movable 2nd substrate stage and; -- The reference mark on said substrate stage And the alignment system for detecting the mark on the induction substrate held on said substrate stage; The 1st length measurement shaft for measuring the location of said 1st shaft orientations of said 1st substrate stage from the one side of the 1st shaft orientations passing through the projection core of said projection optics, and the detection core of said alignment system, The 2nd length measurement shaft for measuring the location of said 1st shaft orientations of said 2nd substrate stage from the other side of said 1st shaft orientations, It has the 3rd length measurement shaft which intersects perpendicularly with said 1st shaft focusing on projection of said projection optics, and the 4th length measurement shaft which intersects perpendicularly with said 1st shaft focusing on detection of said alignment system. With these length measurement shafts The two-dimensional location of said 1st and 2nd substrate stage Interferometer systems measured, respectively; while exposing the induction substrate on one [this] stage, managing the location of one stage of said 1st substrate stage and said 2nd substrate stages using the 3rd length measurement shaft of said interferometer systems While searching for the physical relationship of the mark on the induction substrate held on the stage of said another side, and the reference mark on the stage of said another side using said alignment system, managing the location of the stage of said another side using the 4th length measurement shaft of said interferometer systems After exposure of the induction substrate held on one [said] stage The projection aligner characterized by having the control means which searches for the physical relationship of the projection location of the pattern image of said mask by said

projection optics, and the reference mark on the stage of said another side, managing the location of the stage of said another side using said 3rd length measurement shaft, and;.
[Claim 7] The projection aligner according to claim 6 which is after exposure of the induction substrate held on one [said] stage, and is characterized by resetting the measurement value of the 3rd length measurement shaft of said interferometer systems when searching for the physical relationship of the projection location of the pattern image of said mask by said projection optics, and the reference mark on the stage of said another side.
[Claim 8] the physical relationship of the mark on the induction substrate with which said control means was held on the stage of said another side, and the reference mark on the stage of the another side -- and When the physical relationship of the projection location of the pattern image of said mask by said projection optics and the reference mark on the stage of said another side is searched for The projection aligner according to claim 6 characterized by exposing the induction substrate held on the stage of said another side while controlling the location of the stage of said another side based on the measurement result of the 3rd length measurement shaft of ******.
[Claim 9] Said control means is a projection aligner according to claim 8 characterized by positioning the stage of said another side and exchanging an induction substrate after exposure of the induction substrate held on the stage of said another side so that the reference mark on the stage of said another side may enter in the detection field of said alignment system.
[Claim 10] The projection aligner according to claim 9 characterized by resetting the measurement value of the 4th length measurement shaft of said interferometer systems when detecting the reference mark on the stage of said another side by said alignment system.
[Claim 11] It is the projection aligner which carries out projection exposure of the image of the pattern formed in the mask on an induction substrate through projection optics. Hold an induction substrate and the movable 1st substrate stage and; induction substrate are held for the inside of a two-dimensional flat surface. Carrier system with which said 1st substrate stage delivers an induction substrate for the inside of the same flat surface as said 1st substrate stage between the independently movable 2nd substrate stage, the 1st substrate stage of; above, and said 2nd substrate stage; Said projection optics is established independently. The alignment system for detecting the mark on the substrate held on the reference mark and said substrate stage on said substrate stage; while one stage of said 1st substrate stages and said 2nd substrate stages performs delivery of said carrier system and induction substrate It has the control means which controls said two substrate stages so that the stage of another side performs exposure actuation. This control means The projection aligner characterized by controlling one [said] stage so that the reference mark on one [said] stage enters in the detection field of said alignment system, when one [said] stage delivers an induction substrate between said carrier system.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a projection aligner and the projection exposure approach, and about the projection aligner and the projection exposure approach of carrying out projection exposure of the image of the pattern formed in the mask in more detail on an induction substrate through projection optics, especially, two substrate stages are moved independently and it has the description at the point of performing exposure processing and other processings in parallel.
[0002]
[Description of the Prior Art] Although various aligners are conventionally used when manufacturing a semiconductor device or a liquid crystal display component at a photolithography process, generally in current, the projection aligner imprinted on substrates (an "induction substrate" is called suitably hereafter), such as a wafer with which the photo mask or the pattern image of a reticle (it is hereafter named a "reticle" generically) was applied to sensitization material, such as a photoresist, by the front face through projection optics, or a glass plate, is used. The so-called contraction projection aligner (the so-called stepper) of the step-and-repeat method which lays an induction substrate on a freely movable substrate stage two-dimensional, is made to carry out stepping (stepping) of the induction substrate by this substrate stage as this projection aligner in recent years, and repeats the actuation which carries out sequential exposure of the pattern image of a reticle to each shot field on an induction substrate is in use.
[0003] Comparatively many projection aligners (for example, scanning aligner which was indicated by JP,7-176468,A etc.) of step - which added amelioration to package mold aligners, such as this stepper, and - scanning method have also recently come to be used. It has the equalization effectiveness by carrying out the relative scan of a reticle and the wafer to ** projection optics which can expect a high throughput by reduction of the shots per hour by large field exposure, and has a merit with the expectable improvement in distortion or the depth of focus while manufacture of projection optics is easy for it, since the projection aligner of this step - and - scanning method can expose the large field by smaller optical system compared with ** stepper. Furthermore, since the degree of integration of a semiconductor device becomes [the large field] indispensable still more in the future in connection with DRAM of 16M (megger) to 64M, and becoming high with a time like 256M and 1G (G), it is said that a scanning mold projection aligner will become in use instead of a stepper.
[0004]
[Problem(s) to be Solved by the Invention] It is requested inevitably that the throughput, i.e., a throughput, whether it can carry out exposure processing of the wafer of the number of sheets of which in fixed time amount since this kind of projection aligner is used mainly as mass-production machines, such as a semiconductor device, should be raised.
[0005] About this, in the case of the projection aligner of step - and - scanning method, when exposing the large field, as stated previously, since the shots per hour exposed in a wafer decreases, improvement in a throughput is expected, but From exposure being performed during the uniform migration by synchronous scan with a reticle and a wafer When an acceleration/deceleration space is needed before and behind the uniform migration field and it exposes the shot of magnitude equivalent to a stepper's shot size temporarily, a throughput may fall from a stepper on the contrary.

[0006] The flow of the processing in this kind of projection aligner has become like size Yoji.
[0007] ** The wafer load process which loads a wafer on a wafer table using a wafer loader is performed first.
[0008] ** Next, the search alignment process that a search alignment device performs rough location detection of a wafer is performed. Specifically, this search alignment process is performed by detecting [****] the search alignment mark on a wafer on the basis of the appearance of a wafer.
[0009] ** Next, the fine alignment process which asks for the location of each shot field on a wafer correctly is performed. Generally as for this fine alignment process, an EGA (en hunger strike global alignment) method is used. This method Choose two or more sample shots in a wafer, and sequential measurement of the location of the alignment mark (wafer mark) attached to the sample shot concerned is carried out. Based on this measurement result and the design value of a shot array, the statistics operation by the so-called least square method etc. is performed. It can ask for all the shot array data on a wafer, and can ask for the coordinate location of each shot field comparatively with high precision by the high throughput (reference, such as JP,61-44429,A).
[0010] ** Next, the exposure process which imprints the pattern image of a reticle on a wafer through projection optics is performed, carrying out sequential positioning of each shot field on a wafer in an exposure location based on the coordinate location of each shot field for which it asked with the EGA method mentioned above, and the amount of base lines measured beforehand.
[0011] ** Next, the wafer unload process to which the wafer unload of the wafer on the wafer table by which exposure processing was carried out is carried out using a wafer unloader is performed. This wafer unload process is performed to the wafer load process and coincidence of the above-mentioned ** of a wafer which perform exposure processing. That is, a wafer exchange process is constituted by ** and **.
[0012] thus -- the conventional projection aligner -- wafer exchange -> search alignment -> fine alignment -> exposure -> wafer exchange -- like ...., four actuation is greatly performed repeatedly using one wafer stage.
[0013] Moreover, the throughput THOR of this kind of projection aligner [**/time amount] can express the wafer swap time mentioned above like a degree type (1) for T1 and search alignment time amount, when T2 and fine alignment time amount are made into T3 and the exposure time is made into T four.
[0014]
THOR=3600/(T1+T2+T3+T four) ...... (1)
actuation of the above T1 - T four -- T -- repeat activation is carried out one by one (sequentially) like 1 ->T2 ->T3->T-four->T1 .... For this reason, if each element to T1 - T four is accelerated, a denominator can become small and can raise Throughput THOR. However, since 1 actuation is only performed to one wafer, the effectiveness of an improvement of T1 (wafer swap time) and T2 which were mentioned above (search alignment time amount) is comparatively small. Moreover, in the case of T3 (fine alignment time amount), if the number of samplings of a shot is lessened or the measurement time amount of a shot simple substance is shortened in case the EGA method mentioned above is used, a throughput can be raised, but since alignment precision is made to deteriorate conversely, T3 cannot be shortened easily.
[0015] Moreover, T four (exposure time) includes the wafer exposure time and the stage stepping time between shots. For example, in the case of a scanning projection aligner like step - and - scanning method, although only the part which shortens the wafer exposure time needs to gather the relative scan speed of a reticle and a wafer, a scan speed cannot be easily gathered from synchronous precision deteriorating.
[0016] Moreover, as important conditions, ** resolution, ** depth of focus (DOF:Depth of Forcus), and ** line breadth control precision are mentioned besides the above-mentioned throughput side with this kind of projection aligner. When exposure wavelength is set to lambda and numerical aperture of a projection lens is made into N.A. (Numerical Aperture), resolution R is proportional to lambda/N.A., and the depth of focus DOF is lambda/2 (N.A.). It is proportional.
[0017] For this reason, for raising resolution R (the value of R is made small), it is necessary to make exposure wavelength lambda small or, and it is necessary to enlarge numerical-aperture N.A. Especially, recently, densification, such as a semiconductor device, is progressing, and since a device

rule is becoming below 0.2micromL/S (Rhine - and - tooth space), in order to expose these patterns, KrF excimer laser is used as a source of the illumination light. However, as mentioned above, the degree of integration of a semiconductor device of going up further in the future is inevitable, and development of equipment equipped with the light source [short wavelength / KrF] is desired. Although equipment, an electron ray aligner, etc. which made ArF excimer laser the light source are typically mentioned as a candidate of the equipment of the next generation equipped with such the short wavelength light source In the case of ArF excimer laser, light hardly penetrates in a place with oxygen. When it is hard to come out of high power, the life of laser is also short, and the technical technical problem that equipment cost is high has accumulated. Moreover, since there is un-arranging [that a throughput is remarkable and it is low compared with an optical aligner] in the case of an electron ray aligner, as for development of the next-generation machine which made short wavelength-ization the main viewpoints, not going so that it may consider is actual.
[0018] Although enlarging numerical-aperture N.A. is also considered as other technique of raising resolution R, when N.A. is enlarged, there is a demerit that DOF of projection optics becomes small. This DOF can be divided roughly into UDOF(s) (the part used by the User Depth of Forcus:user side: a pattern level difference, resist thickness, etc.), and the own comprehensive focal difference of equipment. Until now, since the ratio of UDOF was large, the direction which takes large DOF is the main shaft of aligner development, it considers as the technique of taking this large DOF, for example, deformation lighting etc. is put in practical use.
[0019] By the way, although it is necessary to form on a wafer the pattern with which last shipment (Rhine - and - tooth space), Isolation L (Rhine), Isolation S (tooth space) and CH (contact hole), etc. combined in order to manufacture a device, the exposure parameters for performing the optimal exposure for every pattern configurations, such as the above-mentioned last shipment and isolated Rhine, differ. For this reason, it is performed that resolution asks for common exposure parameters (the coherence factor sigma, N.A., exposure control precision, reticle drawing precision, etc.) with which it becomes in a predetermined allowable error, and predetermined DOF is obtained to desired value, and makes this the specification of an aligner conventionally using the technique of ED-TREE (CH from which a reticle differs removes). However, it is thought that there is the following technical flow from now on.
[0020] ** By improvement in process technical (wafer top flattening), the reduction in a pattern level difference and resist thickness reduction may progress, and UDOF may become less than [1micrometer base ->0.4micrometer].
[0021] ** Exposure wavelength has short-wavelength-ized with g line (436nm) ->i line (365nm) ->KrF (248nm). However, only the light source to ArF (193) is examined and the technical hurdle is also high from now on. It shifts to EB exposure after that.
[0022] ** It is expected that scan exposure like step - and - scan becomes the mainstream of a stepper instead of quiescence exposure like step-and-repeat one. Large field exposure is possible for this technique at the small projection optics of a path (especially the scanning direction), and it tends to realize that part quantity N.A.-ization.
[0023] The above technical trends are made into a background, a double exposure method is improved as an approach of raising marginal resolution, in this double exposure method, it uses for an ArF aligner in the future, and KrF and the attempt in which it will expose to 0.1micromL/S are examined. Generally a double exposure method is divided roughly into the following three approaches.
[0024] (1) Form in a separate reticle last shipment and the isolated line by which exposure parameters differ, and expose to a duplex on the same wafer according to the optimal exposure conditions respectively.
[0025] (2) When a phase shift method etc. is introduced, marginal resolution of last shipment is higher than an isolated line at the same DOF. By using this, all patterns are formed by last shipment by the reticle of the 1st sheet, and an isolated line is formed by operating last shipment on a curtailed schedule in the reticle of the 2nd sheet.
[0026] (3) Generally an isolated line can obtain resolution high at small N.A. from last shipment (however, DOF becomes small). Then, all patterns are formed by the isolated line and last shipment is formed with the combination of the isolated line formed by the reticle of the 2nd sheet with the 1st

sheet, respectively.
[0027] The above-mentioned double exposure method has two effectiveness, the improvement in resolution, and the improvement in DOF.
[0028] However, since a double exposure method needs to perform exposure processing two or more times using two or more reticles, From there having been un-arranging [that the exposure time (T four) became more than twice compared with conventional equipment, and a throughput deteriorated sharply], actually The double exposure method is not examined not much earnestly, and improvement in resolution and the depth of focus (DOF) has been conventionally performed by ultraviolet-izing of exposure wavelength, deformation lighting, the phase shift reticle, etc.
[0029] However, when the double exposure method described previously was used for KrF and an ArF aligner, and exposure to 0.1micromL/S was realized, it does not have misgiving that it is the leading alternative of development of the next-generation machine aiming at the mass production of DRAM of 256M and 1G, and it looked forward to development of a new technique for improvement in the throughput which is the technical problem of the double exposure method used as the neck for it.
[0030] If four actuation mentioned above, i.e., wafer exchange, search alignment, fine alignment, and two or more actuation of the exposure actuation can be processed in [that it is also partial] concurrency about this Although it will be the requisite it to be thought compared with the case where these four actuation is performed sequentially for that a throughput can be raised, and to prepare two or more substrate stages for that purpose Although a theory top can regard this as easy, in order to prepare two or more substrate stages actually and to demonstrate sufficient effectiveness, many problems which must be solved have accumulated. For example, in arranging two substrate stages of magnitude comparable as the present condition [only], the installation area (the so-called footprint) of equipment increases remarkably, and there is un-arranging [of causing the cost rise of the clean room on which an aligner is put]. Moreover, since it is necessary to expose by performing alignment of the pattern image of a mask, and an induction substrate using the result of the alignment after performing alignment to the induction substrate on the same substrate stage, in order to realize highly precise superposition, the solution with realistic making one side only into for example, for exposure between two substrate stages, and only making another side only into for alignment etc. cannot change.
[0031] This invention was made under this situation and the 1st purpose is in offering the projection aligner which can attain improvement in a throughput, and small and lightweight-izing of a substrate stage by parallel processing of exposure actuation, alignment actuation, etc.
[0032] Moreover, the 2nd purpose of this invention is to offer the projection exposure approach which can attain improvement in a throughput, and small and lightweight-izing of a stage.
[0033]
[Means for Solving the Problem] Invention according to claim 1 is a projection aligner which carries out projection exposure of the image of the pattern formed in the mask (R) on an induction substrate (W1, W2) through projection optics (PL). Hold an induction substrate (W1) and the movable 1st substrate stage (WS1) and; induction substrate (W2) are held for the inside of a two-dimensional flat surface. The inside of the same flat surface is independently established in the 2nd substrate stage (WS2) where said 1st substrate stage (WS1) is independently movable, and the; aforementioned projection optics (PL) as said 1st substrate stage (WS1). On said substrate stage (WS1, WS2) Or the alignment system for detecting the mark on the induction substrate (W1, W2) held on said substrate stage (WS1, WS2) (for example, 24a); the projection core of said projection optics (PL), and the detection core of said alignment system (24a) The 1st length measurement shaft which always measures the location of said 1st shaft orientations of said 1st substrate stage (WS1) from the one side of the 1st shaft orientations along which it passes (BI1X), The 2nd length measurement shaft which always measures the location of said 1st shaft orientations of said 2nd substrate stage (WS2) from the other side of said 1st shaft orientations (BI2X), The 3rd length measurement shaft which intersects said 1st shaft and perpendicular focusing on projection of said projection optics (PL) (BI3Y), It has the 4th length measurement shaft (BI4Y) which intersects said 1st shaft and perpendicular focusing on detection of said alignment system (24a). With these length measurement shafts (BI1X-BI4Y) The location of one stage of said 1st substrate stage (WS1) and the 2nd substrate

stages (WS2) Interferometer systems which measure the two-dimensional location of said 1st and 2nd substrate stage (WS1 and WS2), respectively; the measurement value of said 3rd length measurement shaft (BI3Y) of said interferometer systems While the induction substrate which used, was managed and was held on one [this] stage is exposed Said 1st substrate stage (WS1) The physical relationship of the alignment mark on the induction substrate held on the stage of another side of the 2nd substrate stages (WS2) and the reference point on the stage of said another side and the detection result of said alignment system (24a), and the measurement value of the 4th length measurement shaft (BI4Y) of said interferometer systems After controlling actuation of said two substrate stages (WS1, WS2) to be used and detected While resetting the interferometer of said 3rd length measurement shaft (BI3Y) using the measurement value of said 3rd length measurement shaft (BI3Y) in the condition in which location measurement of the stage of said another side is possible It has the control means (90) and; which control actuation of the stage of said another side so that the origin/datum on the stage of said another side is positioned in the location which can detect physical relationship with the predetermined origin/datum in the projection field of said projection optics (PL).

[0034] Since the location of the 1st shaft orientations of the 1st substrate stage and the 2nd substrate stage is measured with the 1st length measurement shaft of interferometer systems, and the 2nd length measurement shaft according to this, if the location of a direction perpendicular to the 1st shaft orientations also about which substrate stage is correctly measured at the time of alignment mark measurement etc. at the time of exposure, the two-dimensional location of the 1st and 2nd substrate stage is manageable. In this case, while the induction substrate which the location of one stage of the 1st substrate stage and the 2nd substrate stages was managed using the measurement value of the 3rd length measurement shaft of interferometer systems, and was held in the control means on one [this] stage is exposed The physical relationship of the alignment mark on the induction substrate held on the stage of another side of the 1st substrate stage and the 2nd substrate stages and the reference point on the stage of another side the detection result of an alignment system, and the measurement value of the 4th length measurement shaft of interferometer systems After controlling actuation of two substrate stages to be used and detected, while using the measurement value of the 3rd length measurement shaft and resetting the interferometer of the 3rd length measurement shaft in the condition in which location measurement of the stage of another side is possible Actuation of the stage of another side is controlled so that the origin/datum on the stage of another side is positioned in the location which can detect physical relationship with the predetermined origin/datum in the projection field of projection optics.

[0035] Namely, the induction substrate held in the control means on one [said] stage is received. While exposure of the pattern image of the mask through projection optics is performed managing the location of one stage without an Abbe error using the measurement value of the 3rd length measurement shaft which crosses focusing on projection of projection optics at right angles to the length measurement shaft (the 1st length measurement shaft and the 2nd length measurement shaft) of the 1st shaft orientations The measurement value of the 4th length measurement shaft with which the physical relationship of the alignment mark on the induction substrate held on the stage of another side and the reference point on the stage of another side crosses focusing on detection of the detection result of an alignment system, and an alignment system at right angles to the length measurement shaft (the 1st length measurement shaft and the 2nd length measurement shaft) of the 1st shaft orientations Actuation of two substrate stages is controllable to use and to be detected correctly without an Abbe error. Thus, since exposure actuation on one substrate stage and alignment actuation on the stage of another side can be performed in parallel, it is possible to aim at improvement in a throughput.

[0036] Moreover, after actuation of both the above-mentioned stages is completed, while resetting the interferometer of the 3rd length measurement shaft in the condition in which location measurement of the stage of another side is possible using the measurement value of the 3rd length measurement shaft, actuation of the stage of another side is controlled by the control means so that the origin/datum on the stage of another side is positioned in the location which can detect physical relationship with the predetermined origin/datum in the projection field of projection optics. for this reason, about the stage of another side (alignment was completed) where the physical relationship of

the reference point on a stage and the alignment mark on an induction substrate was measured Even if the 4th length measurement shaft used at the time of measurement of an alignment mark lapses into measurement disabling The location can be managed now using the measurement value of the 3rd length measurement shaft that there is nothing inconvenient [what etc.]. The physical relationship of the reference point on the stage of another side and the predetermined reference point in the projection field of projection optics is detected, and it becomes possible to expose performing alignment of the projection field of projection optics, and an induction substrate using this physical relationship, said alignment measurement result, and the measurement value of the 3rd length measurement shaft. That is, since it becomes possible to perform location management of the stage of another side at the time of exposure with another length measurement shaft even if the length measurement shaft which had managed the location of the stage of another side at the time of alignment serves as measurement impossible, the stage reflector for reflecting the interferometer beam of each above-mentioned length measurement shaft can be miniaturized, and, thereby, a substrate stage can be miniaturized.

[0037] Invention according to claim 2 is set to a projection aligner according to claim 1. It has another alignment system (24b) which has a detection core on said 1st shaft in the opposite side of said alignment system (24a) about said projection optics (PL). Said interferometer systems It has the 5th length measurement shaft (BI5Y) which intersects said 1st shaft and perpendicular focusing on detection of said another alignment system (24b). Said control means (90) While the induction substrate which the location of one [said] stage was managed using the measurement value of said 3rd length measurement shaft (BI3Y) of said interferometer systems, and was held on one [this] stage is exposed So that the physical relationship of the alignment mark on the induction substrate held on the stage of said another side and the reference point on the stage of said another side may be detected using the detection result of said alignment system, and the measurement value of the 4th length measurement shaft (BI4Y) of said interferometer systems actuation of said two substrate stages After controlling, while using the measurement value of said 5th length measurement shaft (BI5Y) and resetting the interferometer of said 5th length measurement shaft (BI5Y) in the condition in which location measurement of one [said] stage is possible It is characterized by controlling actuation of one [said] stage so that the origin/datum on one [said] substrate stage is positioned in the detection field of said another alignment system (24b).

[0038] As opposed to the induction substrate which was held by the control means on one [said] stage according to this While exposure of the pattern image of the mask through projection optics is performed managing the location of one stage without an Abbe error using the measurement value of the 3rd length measurement shaft which crosses focusing on projection of projection optics at right angles to the length measurement shaft (the 1st length measurement shaft and the 2nd length measurement shaft) of the 1st shaft orientations The measurement value of the 4th length measurement shaft with which the physical relationship of the alignment mark on the induction substrate held on the stage of another side and the reference point on the stage of another side crosses focusing on detection of the detection result of an alignment system, and an alignment system at right angles to the length measurement shaft (the 1st length measurement shaft and the 2nd length measurement shaft) of the 1st shaft orientations Actuation of two substrate stages can be controlled, it will do in this way, and exposure actuation on one substrate stage and alignment actuation on the stage of another side will be performed in parallel so that it may use and may be detected correctly without an Abbe error.

[0039] Moreover, in the detection field of another alignment system, after actuation of both the above-mentioned stages is completed, while resetting the interferometer of the 5th length measurement shaft in the condition in which location measurement of one stage is possible using the measurement value of the 5th length measurement shaft, the origin/datum on one substrate stage controls actuation of a stage by the control means so that while is positioned. The exposure to an induction substrate was completed by while. For this reason, about a stage Even if the 3rd length measurement shaft used at the time of exposure will be in measurement disabling, that there is nothing inconvenient [what etc.] The location can be managed now without an Abbe error using the measurement value of the 5th length measurement shaft which crosses focusing on detection of another alignment system at right angles to the length measurement shaft (the 1st length

measurement shaft and the 2nd length measurement shaft) of the 1st shaft orientations. The location of the ARAMENTO mark of the induction substrate held by another alignment system on the location of the origin/datum on one substrate stage and one stage can be succeedingly measured now to exposure. Therefore, shift two substrate stages to the 1st shaft orientations, and location measurement of the substrate stage of another side which alignment actuation ended resets the interferometer of the 3rd length measurement shaft in the possible condition using the measurement value of the 3rd length measurement shaft. When while was completed and exposure actuation resets the interferometer of the 5th length measurement shaft in the condition in which location measurement of a stage is possible using the measurement value of the 5th length measurement shaft, it becomes possible to change easily the exposure actuation by the side of one stage, and the exposure actuation by the side of the stage of another side.

[0040] In having further the carrier system (180-200) which delivers an induction substrate (W1, W2) like invention according to claim 3 between the 1st substrate stage (WS1) and the 2nd substrate stage (WS2), in this case, said control means It is desirable that it is made to deliver a substrate between one [said] stage and said carrier system (180-200) where the origin/datum on one [said] substrate stage is positioned in the detection field of said another alignment system (24b). Since delivery of a substrate is performed between one stage and carrier system in addition to a change in the above-mentioned exposure actuation and alignment actuation where the origin/datum on one substrate stage is positioned in the detection field of another alignment system with reset of the 5th length measurement shaft of interferometer systems by the control means when doing in this way, the location measurement of an origin/datum and the exchange of an induction substrate which are alignment initiation actuation can be performed by the quiescent state of a substrate stage. Furthermore, since it becomes possible to perform actuation of the time amount T1, the time amount T2, and time amount T3 which were explained previously by one substrate stage side in addition to the transit time of the substrate stage from a substrate exchange location to an alignment starting position serving as zero, and to operate time amount T four by the substrate stage side of another side, even if compared with the case of invention according to claim 2, it becomes possible to aim at improvement in a throughput further.

[0041] Invention according to claim 4 is set to a projection aligner according to claim 1. On said 1st substrate stage (WS1) and said 2nd substrate stage (WS2), the reference mark (MK1, MK2, MK3) as a reference point of said stage is formed, respectively. The predetermined reference point in the projection field of said projection optics (PL) is based on projection of the pattern image of said mask (R). It is characterized by having further a mark location detection means (142,144) to detect the relative-position relation between the projection core of the pattern image of said mask (R), and the reference mark on said stage through said mask (R) and said projection optics (PL).

[0042] As opposed to the induction substrate which was held by the control means on one stage according to this While exposure of the pattern image of the mask through projection optics is performed managing the location of one stage without an Abbe error using the measurement value of the 3rd length measurement shaft So that the physical relationship of the alignment mark on the induction substrate held on the stage of another side and the reference mark on the stage of another side (MK2) may be detected correctly without an Abbe error using the detection result of an alignment system (24a), and the measurement value of the 4th length measurement shaft Actuation of two substrate stages can be controlled, it will do in this way, and exposure actuation on one substrate stage and alignment actuation on the stage of another side will be performed in parallel.

[0043] Moreover, after actuation of both the above-mentioned stages is completed, while resetting the interferometer of the 3rd length measurement shaft in the condition in which location measurement of the stage of another side is possible using the measurement value of the 3rd length measurement shaft, actuation of the stage of another side is controlled by the control means so that the origin/datum on the stage of another side (MK1, MK3) is positioned in the location which can detect the physical relationship based on [of the pattern image of a mask] projection. for this reason, about the stage of another side where the physical relationship of the reference point on a stage (MK2) and the alignment mark on an induction substrate was measured Even if the 4th length measurement shaft used at the time of measurement of an alignment mark will be in measurement disabling The location can be managed now using the measurement value of the 3rd length

measurement shaft that there is nothing inconvenient [what etc.]. Are detectable using a mark location detection means (142,144) to detect the reference point on the stage of another side (MK1, MK3), and the relative-position relation based on [of the pattern image of a mask] projection through a mask (R) and projection optics (PL). It becomes possible to expose performing alignment of the pattern image of a mask and induction substrate by projection optics (PL) using this physical relationship, said alignment measurement result, and the measurement value of the 3rd length measurement shaft.

[0044] Invention according to claim 5 is the projection exposure approach which carries out projection exposure of the image of the pattern of a mask (R) on an induction substrate (W1, W2) through projection optics (PL). While an induction substrate (W1, W2) is held, two independently movable substrate stages (WS1, WS2) are respectively prepared for the inside of the same flat surface and a; predetermined interferometer performs one location measurement of said two stages Projection exposure of the pattern image of said mask is carried out on the induction substrate held on one [this] stage. While an interferometer other than said predetermined interferometer performs location measurement of the stage of another side of said two stages during exposure of the substrate held on one [said] stage After exposure termination of the induction substrate which measured the physical relationship of the alignment mark on the induction substrate held on the stage of this another side, and the origin/datum on the stage of said another side, and was held on; aforementioned one stage While resetting said predetermined interferometer with said predetermined interferometer in the condition in which location measurement of the stage of said another side is possible It is based on the physical relationship by which positioned the origin/datum of the stage of said another side in the location which can detect physical relationship with the predetermined origin/datum in the projection field of said projection optics, and the; aforementioned measurement was carried out. It is characterized by performing alignment of the induction substrate and the pattern image of a mask which were held on the stage of said another side using said reset predetermined interferometer.

[0045] According to this, measurement (alignment actuation) of the physical relationship of exposure actuation of the induction substrate held on one stage, and the alignment mark of the induction substrate held on the stage of another side and the reference point on this stage is performed in parallel. Under the present circumstances, the location of one stage is managed by the predetermined interferometer, and the location of the stage of another side is managed by another interferometer. And after the exposure actuation by the side of one stage is completed, while the predetermined interferometer is reset in the condition in which location measurement of the stage of another side is possible by the predetermined interferometer which had managed the location of the stage which is one side till then, the origin/datum of the stage of another side is positioned in the location which can detect physical relationship with the predetermined origin/datum in the projection field of projection optics. Then, based on the physical relationship of the alignment mark on the induction substrate held on the stage of another side measured previously, and the origin/datum on the stage of another side, alignment of the induction substrate and the pattern image of a mask which were held on the stage of another side using the reset predetermined interferometer is performed, and projection exposure of the pattern image of a mask is carried out on an induction substrate.

[0046] Namely, after exposure actuation of the induction substrate held on one substrate stage and alignment actuation of the induction substrate held on the stage of another side are performed in parallel If the stage of another side is moved to the direction of projection optics in parallel to one substrate stage evacuating to a predetermined substrate exchange location and the stage of the another side comes the location to a location measurable [with a predetermined interferometer] The predetermined interferometer concerned is reset. The predetermined reference point in the projection field of projection optics If the reference point of the stage of another side is positioned in the location which can detect the physical relationship (for example, based on [of the pattern image of a mask] projection) and both physical relationship is detected This detection result Alignment of the induction substrate and the pattern image of a mask which were held on the stage of another side is performed at the time of exposure, managing a location with the predetermined interferometer after reset based on the physical relationship of the reference point on the stage previously measured on the occasion of alignment actuation, and an alignment mark.

[0047] Therefore, while being able to aim at improvement in a throughput by performing exposure

actuation of the induction substrate on one substrate stage, and alignment actuation of the induction substrate on the substrate stage of another side in parallel Even if another interferometer which had managed the location of the stage of another side at the time of alignment serves as measurement impossible Since it becomes possible to perform location management of the stage of another side at the time of exposure with a predetermined interferometer, the stage reflector for reflecting the interferometer beam of each above-mentioned interferometer can be miniaturized, and, thereby, a substrate stage can be miniaturized.

[0048] Invention according to claim 6 is a projection aligner which carries out projection exposure of the image of the pattern formed in the mask (R) on an induction substrate (W1, W2) through projection optics (PL). Hold an induction substrate (W1) and the movable 1st substrate stage (WS1) and; induction substrate (W2) are held for the inside of a two-dimensional flat surface. The inside of the same flat surface is independently established in the 2nd substrate stage (WS2) where said 1st substrate stage (WS1) is independently movable, and the; aforementioned projection optics (PL) as said 1st substrate stage (WS1). The alignment system for detecting the mark on the induction substrate held on the reference mark and said substrate stage on said substrate stage (WS1, WS2) (for example, 24a); the projection core of said projection optics (PL), and the detection core of said alignment system (24a) The 1st length measurement shaft for measuring the location of said 1st shaft orientations of said 1st substrate stage (WS1) from the one side of the 1st shaft orientations along which it passes (BI1X), The 2nd length measurement shaft for measuring the location of said 1st shaft orientations of said 2nd substrate stage (WS2) from the other side of said 1st shaft orientations (BIX2), The 3rd length measurement shaft which intersects perpendicularly with said 1st shaft focusing on projection of said projection optics (PL) (BI3Y), It has the 4th length measurement shaft (BI4Y) which intersects perpendicularly with said 1st shaft focusing on detection of said alignment system (24a). With these length measurement shafts (BI1X-BI4Y) The location of one stage of said 1st substrate stage (WS1) and said 2nd substrate stages (WS2) Interferometer systems which measure the two-dimensional location of said 1st and 2nd substrate stage (WS1 and WS2), respectively; the 3rd length measurement shaft (BI3Y) of said interferometer systems While exposing the induction substrate on one [this] stage, using and managing While searching for the physical relationship of the mark on the induction substrate held on the stage of said another side, and the reference mark on the stage of said another side using said alignment system (24a), managing the location of the stage of said another side using the 4th length measurement shaft (BI4Y) of said interferometer systems After exposure of the induction substrate held on one [said] stage It has the control means (90) and; which search for the physical relationship of the projection location of the pattern image of said mask by said projection optics (PL), and the reference mark on the stage of said another side, managing the location of the stage of said another side using said 3rd length measurement shaft (BI3Y).

[0049] While exposing the induction substrate on one [this] stage by the control means according to this, managing the location of one stage of the 1st substrate stage and the 2nd substrate stages using the measurement value of the 3rd length measurement shaft of interferometer systems While searching for the physical relationship of the mark on the induction substrate held on the stage of another side, and the reference mark on the stage of another side using an alignment system The physical relationship of the projection location of the pattern image of the mask by projection optics and the reference mark on the stage of another side is searched for using the 3rd length measurement shaft and managing the location of the stage of another side after exposure of the induction substrate held on one stage.

[0050] Namely, the induction substrate held in the control means on one [said] stage is received. While exposure of the pattern image of the mask through projection optics is performed managing the location of one stage without an Abbe error using the measurement value of the 3rd length measurement shaft which intersects perpendicularly with the length measurement shaft (the 1st length measurement shaft and the 2nd length measurement shaft) of the 1st shaft orientations focusing on projection of projection optics The measurement value of the 4th length measurement shaft which intersects perpendicularly with the length measurement shaft (the 1st length measurement shaft and the 2nd length measurement shaft) of the 1st shaft orientations the physical relationship of the mark on the induction substrate held on the stage of another side, and the

reference mark on the stage of another side focusing on detection of the detection result of an alignment system, and an alignment system Since it can use, it can detect correctly without an Abbe error, it can do in this way and exposure actuation on one substrate stage and alignment actuation on the stage of another side can be performed in parallel, it is possible to aim at improvement in a throughput.

[0051] Moreover, in a control means, the physical relationship of the projection location of the pattern image of the mask by projection optics and the reference mark on the stage of another side is searched for, using the 3rd length measurement shaft and managing the location of the stage of another side after exposure of the induction substrate held on one stage, i.e., termination of both the above-mentioned stages of operation. for this reason, about the stage of another side (alignment was completed) where the physical relationship of the reference mark on a stage and the alignment mark on an induction substrate was measured Even if the 4th length measurement shaft used at the time of measurement of an alignment mark lapses into measurement disabling The location can be managed now using the measurement value of the 3rd length measurement shaft that there is nothing inconvenient [what etc.]. It asks for the relation between the reference mark on the stage of another side, and the projection location of the pattern image of the mask by projection optics. It becomes possible to expose performing alignment of the projection field of projection optics, and an induction substrate using this physical relationship, said alignment measurement result, and the measurement value of the 3rd length measurement shaft. That is, since another length measurement shaft performs location management of the stage of another side at the time of exposure even if the length measurement shaft which had managed the location of the stage of another side at the time of alignment serves as measurement impossible, the stage reflector for reflecting the interferometer beam of each above-mentioned length measurement shaft can be miniaturized, and, thereby, a substrate stage can be miniaturized.

[0052] In this case, it is after exposure of the induction substrate held like invention according to claim 7 on one [said] stage, and when searching for the physical relationship of the projection location of the pattern image of said mask (R) by said projection optics (PL), and the reference mark on the stage of said another side, you may make it reset the measurement value of the 3rd length measurement shaft (BI3Y) of said interferometer systems.

[0053] Invention according to claim 8 is set to a projection aligner given in above-mentioned claim 6. Said control means (90) the physical relationship of the mark on the induction substrate held on the stage of said another side, and the reference mark on the stage of the another side -- and When the physical relationship of the projection location of the pattern image of said mask by said projection optics and the reference mark on the stage of said another side is searched for It is characterized by exposing the induction substrate held on the stage of said another side, controlling the location of the stage of said another side based on the measurement result of the 3rd length measurement shaft of ******.

[0054] the physical relationship (a sensor with this same --) of the mark on the induction substrate which was held on the stage of another side according to this, and the reference mark on the stage of the another side that is, and it asks by the alignment system Since the induction substrate held on the stage of another side is exposed controlling the location of the stage of another side based on the measurement result of the 3rd length measurement shaft when searching for the physical relationship of the projection location of the pattern image of the mask by projection optics, and the reference mark on the stage of another side Even if the 4th length measurement shaft which had managed the location of the stage of another side serves as measurement impossible when the physical relationship is searched for after searching for the physical relationship of the mark on the induction substrate held on the stage of another side, and the reference mark on the stage of the another side It becomes possible to position an induction substrate in an exposure location with high precision in the case of exposure, without any un-arranging arising.

[0055] In this case, as for said control means (90), it is desirable like invention according to claim 9 that the stage of said another side is positioned and it is made to exchange an induction substrate after exposure of the induction substrate held on the stage of said another side so that the reference mark on the stage of said another side may enter in the detection field of said alignment system.

[0056] Since substrate exchange on the stage of another side is performed by the control means

where the reference mark on the substrate stage of another side is positioned in the detection field of an alignment system when doing in this way, alignment initiation actuation and exchange of an induction substrate can be performed by the quiescent state of a substrate stage. Furthermore, since it becomes possible to perform actuation of the time amount T1, the time amount T2, and time amount T3 which were explained previously by the substrate stage side of another side in addition to the transit time of the substrate stage from a substrate exchange location to an alignment starting position serving as zero, and to operate time amount T four by one substrate stage side, improvement in a throughput is possible.
[0057] Moreover, when detecting the reference mark on the stage of said another side by said alignment system, you may make it reset the measurement value of the 4th length measurement shaft of said interferometer systems like invention according to claim 10 in this case.
[0058] Invention according to claim 11 is a projection aligner which carries out projection exposure of the image of the pattern formed in the mask (R) on an induction substrate (W) through projection optics (PL). Hold an induction substrate (W1) and the movable 1st substrate stage (WS1) and; induction substrate (W2) are held for the inside of a two-dimensional flat surface. The inside of the same flat surface as said 1st substrate stage (WS1) Said 1st substrate stage Said projection optics (PL) is established independently. the 2nd substrate stage (WS2) where (WS1) is independently movable, and; -- the carrier system (180-200) and; which deliver an induction substrate between said 1st substrate stage (WS1) and said 2nd substrate stage (WS2) -- The reference mark on said substrate stage And the mark on the induction substrate held on said substrate stage The alignment system for detecting (for example, 24a); while one stage of said 1st substrate stages (WS1) and said 2nd substrate stages (WS2) delivers an induction substrate between said carrier system (180-200) It has the control means (90) which controls said two substrate stages so that the stage of another side performs exposure actuation. This control means (90) When one [said] stage delivers an induction substrate between said carrier system, it is characterized by controlling one [said] stage so that the reference mark on one [said] stage enters in the detection field of said alignment system.
[0059] According to this, actuation of both stages is controlled so that the stage of another side performs exposure actuation by the control means, while one stage of the 1st substrate stage and the 2nd substrate stages delivers an induction substrate between carrier system. Therefore, parallel processing of actuation of the time amount T1 explained previously and the actuation of time amount T four can be carried out. Moreover, a control means can perform the location measurement of a reference mark and the exchange of an induction substrate which are alignment initiation actuation since a stage is controlled so that the reference mark on one stage enters in the detection field of an alignment system in while when one stage delivers an induction substrate between carrier system by the quiescent state of a substrate stage. Furthermore, it becomes possible to perform actuation of the time amount T1, the time amount T2, and time amount T3 which were explained previously by one substrate stage side in addition to the transit time of the substrate stage from a substrate exchange location to an alignment starting position serving as zero, and to operate time amount T four by the substrate stage side of another side. Therefore, it becomes possible to raise a throughput compared with the conventional sequential processing in which time amount (T1+T2+T3+T four) was required.
[0060]
[Embodiment of the Invention]
<< -- 1st operation gestalt>> -- the 1st operation gestalt of this invention is hereafter explained based on drawing 1 thru/or drawing 15 .
[0061] The outline configuration of the projection aligner 10 concerning 1 operation gestalt is shown in drawing 1 . This projection aligner 10 is a projection aligner of the scan exposure mold of so-called step - and - scanning method.
[0062] The 1st by which the base board 12 top is held, respectively and this projection aligner 10 moves independently the wafers W1 and W2 as an induction substrate in the two-dimensional direction in it, stage equipment equipped with the wafer stages WS1 and WS2 as 2nd substrate stage, The reticle R as a mask in the upper part of the projection optics PL arranged above this stage equipment, and projection optics PL A predetermined scanning direction mainly, Here, it has the control system which controls the reticle drive driven to Y shaft orientations (the space rectangular

cross direction in drawing 1), the illumination system which illuminates Reticle R from the upper part, and these each part.

[0063] said stage equipment carries out surfacing support through a non-illustrated air bearing on the base board 12 -- having -- X shaft orientations (space longitudinal direction in drawing 1), and Y shaft orientations (the space rectangular cross direction in drawing 1) -- becoming independent -- two-dimensional -- it has two movable wafer stages WS1 and WS2, the stage drive system which drives these wafer stages WS1 and WS2, and the interferometer systems which measure the location of the wafer stages WS1 and WS2.

[0064] If this is explained further in full detail, the non-illustrated air pad (for example, vacuum precompression mold air bearing) is prepared in the base of the wafer stages WS1 and WS2 at two or more places, and where spacing of several microns is maintained by balance of air ********** of this air pad, and a vacuum precharge pressure, surfacing support is carried out on the base board 12.

[0065] On the base board 12, as shown in the top view of drawing 3 , the X-axis linear guides (for example, a thing like the fixed side magnet of the so-called linear motor of a moving coil type) 122 and 124 of two prolonged in X shaft orientations are formed in parallel, and two movable migration members 114 and 118 each, and 116 and 120 are attached along with the X shaft each linear guide concerned at these X-axis linear guides 122 and 124, respectively. The non-illustrated drive coil is attached in the bottom surface part of these four migration members 114, 118, 116, and 120, respectively so that the X-axis linear guide 122 or 124 may be surrounded from the upper part and the side, and the linear motor of the moving coil type which drives each migration members 114, 116, 118, and 120 to X shaft orientations is constituted by these drive coils, the X-axis linear guide 122, or 124, respectively. However, in the following explanation, the above-mentioned migration members 114, 116, 118, and 120 shall be called an X-axis linear motor for convenience.

[0066] Among these, two X-axis linear motors 114 and 116 are formed in the both ends of the Y-axis linear guide (for example, a thing like the fixed side coil of the linear motor of a MUBINGU magnet mold) 110 prolonged in Y shaft orientations, respectively, and remaining two X-axis linear motors 118 and 120 are being fixed to the both ends of the same Y-axis linear guide 112 prolonged in Y shaft orientations. Therefore, the Y-axis linear guide 110 is driven along with the X-axis linear guides 122 and 124 with the X-axis linear motors 114 and 116, and drives the Y-axis linear guide 112 along with the X-axis linear guides 122 and 124 with the X-axis linear motors 118 and 120.

[0067] On the other hand, the magnet which is not illustrated [which surrounds one Y-axis linear guide 110 from the upper part and the side] is prepared in the pars basilaris ossis occipitalis of the wafer stage WS 1, and the linear motor of the MUBINGU magnet mold which drives the wafer stage WS 1 to Y shaft orientations with this magnet and the Y-axis linear guide 110 is constituted. Moreover, the magnet which is not illustrated [which surrounds the Y-axis linear guide 112 of another side from the upper part and the side] is prepared in the pars basilaris ossis occipitalis of the wafer stage WS 2, and the linear motor of the MUBINGU magnet mold which drives the wafer stage WS 2 to Y shaft orientations with this magnet and the Y-axis linear guide 112 is constituted.

[0068] That is, the stage drive system which carries out independently XY two-dimensional drive of the wafer stages WS1 and WS2 with the magnet which is not illustrated [of the X-axis linear guides 122 and 124 mentioned above, the X-axis linear motors 114, 116, 118, and 120, the Y-axis linear guides 110 and 112 and the wafer stage WS 1, and WS2 pars basilaris ossis occipitalis] consists of these operation gestalten. This stage drive system is controlled by the stage control unit 38 of drawing 1 .

[0069] In addition, it is carrying out adjustable [of the torque of the X-axis linear motors 114 and 116 of a pair prepared in the both ends of the Y-axis linear guide 110] a little, and it is also possible to make the wafer stage WS 1 generate very small yawing, or to remove on it. It is similarly carrying out adjustable [of the torque of the X-axis linear motors 118 and 120 of a pair prepared in the both ends of the Y-axis linear guide 112] a little, and it is also possible to make the wafer stage WS 2 generate very small yawing, or to remove on it.

[0070] On said wafer stages WS [WS1 and] 2, wafers W1 and W2 are being fixed by vacuum adsorption etc. through the non-illustrated wafer holder. The minute drive of the wafer holder is carried out by the non-illustrated Z-theta drive in Z shaft orientations and the direction (hand of cut of the circumference of the Z-axis) of theta which intersect perpendicularly with XY flat surface.

Moreover, it is installed in the top face of the wafer stages WS1 and WS2 so that the reference mark plates FM1 and FM2 with which various reference marks were formed may become the respectively almost same height as wafers W1 and W2. These reference mark plates FM1 and FM2 are used in case the criteria location of for example, each wafer stage is detected.
[0071] Moreover, the field 20 by the side of the X shaft orientations 1 of the wafer stage WS 1 (left lateral in drawing 1) and the field 21 by the side of the Y shaft orientations 1 (field by the side of the space back in drawing 1) It is the reflector where mirror plane finishing was made, and the field (right lateral in drawing 1) 22 of a side besides X shaft orientations of the wafer stage WS 2 and the field 23 by the side of one of Y shaft orientations are the reflector where mirror plane finishing was made similarly. By being projected on the interferometer beam of each length measurement shaft which constitutes the interferometer systems mentioned later, and receiving the reflected light with each interferometer, to these reflectors, the variation rate from the criteria location (generally a fixed mirror is arranged on a projection optics side face and the side face of alignment optical system, and let that be a datum plane) of each reflector is measured, and, thereby, the two-dimensional location of the wafer stages WS1 and WS2 is measured, respectively. In addition, the configuration of the length measurement shaft of interferometer systems is explained in full detail behind.
[0072] As said projection optics PL, it consists of two or more lens element which has the common optical axis of Z shaft orientations, and the contraction scale factor predetermined by the both-sides tele cent rucksack, for example, the dioptric system which has 1/5, is used here. For this reason, the passing speed of the scanning direction of the wafer stage at the time of scan exposure of step - and - scanning method is set to one fifth of the passing speed of a reticle stage.
[0073] The alignment systems 24a and 24b of the off-axis (off-axis) method which had the same function in the both sides of X shaft orientations of this projection optics PL as shown in drawing 1 are installed in the location which only the same distance separated from the optical-axis core (the projection core of a reticle pattern image, and coincidence) of projection optics PL, respectively. These alignment systems 24a and 24b have three kinds of alignment sensors, a LSA (Laser Step Alignment) system, a FIA (Filed Image Alignment) system, and a LIA (Laser Interferometric Alignment) system, and it is possible to perform X of the reference mark on a reference mark plate and the alignment mark on a wafer and location measurement of the Y two-dimensional direction.
[0074] Here, a LSA system irradiates a laser beam at a mark, is flexible sensor that measures a mark location using diffraction and the scattered light, and is used for a broad process wafer from the former. A FIA system illuminates a mark with broadband (broadband) light, such as a halogen lamp, by carrying out the image processing of this mark image, is a sensor which measures a mark location and is used effective in the unsymmetrical mark on an aluminum layer or the front face of a wafer. Moreover, a LIA system makes the two diffracted lights which irradiated the laser beam which changed the frequency into the diffraction-grating-like mark slightly from the 2-way, and were generated interfere, is a sensor which detects the positional information of a mark from the phase, and is used effective in a low level difference or a surface dry-area wafer.
[0075] With this operation gestalt, these three kinds of alignment sensors are properly used according to the purpose suitably, and the so-called search alignment which detects the location of the single dimension mark of three points on a wafer, and performs outline location measurement of a wafer, fine alignment which performs exact location measurement of each shot field on a wafer are performed.
[0076] In this case, alignment system 24a is used for location measurement of the reference mark formed on the alignment mark on the wafer W1 held on the wafer stage WS 1, and the reference mark plate FM 1 etc. Moreover, alignment system 24b is used for location measurement of the reference mark formed on the alignment mark on the wafer W2 held on the wafer stage WS 2, and the reference mark plate FM 2 etc.
[0077] A/D conversion of the information from each alignment sensor which constitutes these alignment systems 24a and 24b is carried out by the alignment control device 80, data processing of the digitized wave signal is carried out, and a mark location is detected. This result is sent to a main control unit 90, and the synchronous location amendment at the time of exposure etc. is directed from a main control unit 90 to a stage control unit according to that result.
[0078] Furthermore, although illustration was omitted at drawing 1 in the aligner 10 of this operation

gestalt As [show / at drawing 5 / above Reticle R] Projection optics PL is minded. As a mark location detection means of the pair which consists of the TTR (Through The Reticle) alignment optical system using the exposure wavelength for observing the reticle mark on Reticle R (illustration abbreviation), and the mark on the reference mark plates FM [FM1 and] 2 to coincidence The ** reticle alignment microscopes 142 and 144 are formed. The detecting signal of these reticle alignment microscopes 142 and 144 is supplied to a main control unit 90. In this case, if the deviation mirrors 146 and 148 for leading the detection light from Reticle R to the reticle alignment microscopes 142 and 144, respectively are arranged free [migration] and an exposure sequence is started, the deviation mirrors 146 and 148 will shunt with a non-illustrated mirror driving gear under the command from a main control unit 90, respectively. In addition, since it is indicated by JP,7-176468,A etc., a configuration equivalent to the reticle alignment microscopes 142 and 144 is omitted about detailed explanation here.

[0079] Moreover, although illustration was omitted in drawing 1 , as shown in drawing 4 , the automatic focus / auto leveling measuring machine styles 130, 132, and 134 for investigating a focus location (henceforth a "AF/AL system") are formed in each of projection optics PL and the alignment systems 24a and 24b. In order for the AF/AL system 132 to imprint the pattern on Reticle R correctly on a wafer (W1 or W2) by scanning exposure among this From the pattern formation side on Reticle R and the exposure side of Wafer W being conjugate about projection optics PL It is prepared in order to detect whether the exposure side of Wafer W has agreed within the limits of the depth of focus in the image surface of projection optics PL (is it focusing or not?). With this operation gestalt, the so-called multipoint AF system is used as an AF/AL system 132.

[0080] Here, the detail configuration of the multipoint AF system which constitutes this AF/AL system 132 is explained based on drawing 5 and drawing 6 .

[0081] This AF/AL system (multipoint AF system) 132 consists of exposure optical system 151 which consists of an optical fiber bundle 150, a condenser lens 152, the pattern formation plate 154, a lens 156, a mirror 158, and the exposure objective lens 160, and condensing optical system 161 which consists of the condensing objective lens 162, the hand-of-cut diaphragm 164, the image formation lens 166, and an electric eye 168, as shown in drawing 5 .

[0082] Here, above-mentioned each part of a configuration of this AF/AL system (multipoint AF system) 132 is explained with that operation.

[0083] The illumination light of wavelength which does not expose the photoresist on a different wafer W1 (or W2) from the exposure light EL is drawn through an optical fiber bundle 150 from the source of the illumination light which is not illustrated, and the illumination light injected from this optical fiber bundle 150 illuminates the pattern formation plate 154 through a condenser lens 152. The illumination light which penetrated this pattern formation plate 154 is projected on the exposure side of Wafer W through a lens 156, a mirror 158, and the exposure objective lens 160, and projection image formation of the image of the pattern on the pattern formation plate 154 is aslant carried out to an optical axis AX to the exposure side of a wafer W1 (or W2). The illumination light reflected with the wafer W1 is projected on the light-receiving side of an electric eye 168 through the condensing objective lens 162, the hand-of-cut diaphragm 164, and the image formation lens 166, and re-image formation of the image of the pattern on the pattern formation plate 154 is carried out to the light-receiving side of an electric eye 168. Here, a main control unit 90 supplies the detecting signal from many (specifically, it is the slit pattern and the same number of the pattern formation plate 154) photo detectors of an electric eye 168 to a signal processor 170 while giving a predetermined vibration to the hand-of-cut diaphragm 164 through excitation equipment 172. Moreover, a signal processor 170 supplies the focal signal of a large number which carried out the synchronous detection of each detecting signal, and obtained it with the driving signal of excitation equipment 172 to a main control unit 90 through the stage control unit 38.

[0084] In this case, as shown in the pattern formation plate 154 at drawing 6 , the opening pattern 93-11 to 93-59 of the shape of a slit of the 5x9=45 piece vertical direction is formed, and the image of the opening pattern of the shape of these slit is projected aslant (45 degrees) to the X-axis and a Y-axis on the exposure side of Wafer W. Consequently, the slit image of the matrix arrangement which inclined at 45 degrees to the X-axis and a Y-axis as shown in drawing 4 is formed. In addition, the sign IF in drawing 4 shows the lighting field on the reticle illuminated by the illumination system,

and the lighting field on a wafer [****]. The beam for detection is irradiated by two-dimensional sufficiently larger area than the lighting field IF under projection optics PL so that clearly also from this drawing 4 .

[0085] The other AF/AL systems 130 and 134 as well as this AF/AL system 132 are constituted. That is, with this operation gestalt, it has composition which can irradiate a detection beam also according to the AF/AL devices 130 and 134 in which it is used at the time of measurement of an alignment mark of the almost same field as the AF/AL system 132 used for the focal detection at the time of exposure. For this reason, highly precise alignment measurement is attained by performing location measurement of an alignment mark, performing the automatic focus / auto leveling by measurement of the same AF/AL system as the time of exposure, and control at the time of measurement of the alignment sensor by the alignment systems 24a and 24b. If it puts in another way, the offset (error) by the posture of a stage will not occur between the times of exposure and alignment.

[0086] Next, a reticle drive is explained based on drawing 1 and drawing 2 .

[0087] This reticle drive is equipped with the linear motor which is not illustrated [which holds Reticle R for the reticle base board 32 top, and drives the movable reticle stage RST and this reticle stage RST in the two-dimensional direction of XY], and the reticle interferometer systems which manage the location of this reticle stage RST.

[0088] When this is explained further in full detail, in a reticle stage RST As shown in drawing 2 , the reticles R1 and R2 of two sheets can install now in the scanning direction (Y shaft orientations) at a serial. This reticle stage RST Surfacing support is carried out on the reticle base board 32 through a non-illustrated pneumatic bearing etc., and minute rotation of the minute drive of X shaft orientations and the direction of theta and the scan drive of Y shaft orientations are made by the drive 30 (refer to drawing 1) which consists of a non-illustrated linear motor etc. In addition, although a drive 30 is a device which makes a driving source the same linear motor as the stage equipment mentioned above, by drawing 1 , illustration reaches for convenience and it is shown as a mere block from on [of explanation] expedient. For this reason, in case the reticles R1 and R2 on a reticle stage RST are double exposure, it is used alternatively, and it has composition which can carry out a synchronous scan a wafer side also about which reticle.

[0089] The parallel monotonous migration mirror 34 which changes from the same materials (for example, ceramic etc.) as a reticle stage RST to the edge by the side of one of X shaft orientations on this reticle stage RST is installed by Y shaft orientations, and the reflector is formed in the field by the side of one of X shaft orientations of this migration mirror 34 of mirror plane processing. The interferometer beam from the interferometer shown by length measurement shaft BI6X which constitutes the interferometer systems 36 of drawing 1 towards the reflector of this migration mirror 34 is irradiated, and the location of a reticle stage RST is measured in the interferometer by receiving that reflected light and measuring the relative displacement over a datum plane like a wafer stage side. Here, the interferometer which has this length measurement shaft BI6X has two independently measurable interferometer opticals axis in fact, and location measurement of X shaft orientations of a reticle stage and measurement of the amount of YOINGU are possible for it. The interferometer which has this length measurement shaft BI6X is used in order to carry out the roll control of the reticle stage RST to a reticle in the direction which cancels relative rotation (rotational error) of a wafer based on the yawing information and X positional information of the wafer stages WS1 and WS2 from interferometers 16 and 18 which have length measurement shaft BI1X by the side of the wafer stage mentioned later, and BI2X or to perform the direction synchronousr control of X.

[0090] On the other hand, the cube-corner-reflector mirrors 35 and 37 of a pair are installed in the side (space near side in drawing 1) besides Y shaft orientations which are scanning directions (the scanning direction) of a reticle stage RST. As opposed to the double pass interferometer of a non-illustrated pair to these cube-corner-reflector mirrors 35 and 37 to drawing 2 And length measurement shaft BI7Y, The interferometer beam shown by BI8Y is irradiated, and it is returned to the reflector on the reticle base board 32 from the cube-corner-reflector mirrors 35 and 37. Then, each reflected reflected light is received with return and each double pass interferometer in the same optical path, and the relative displacement from the criteria location (it is a reflector on said reticle base board 32 at a reference position) of each cube-corner-reflector mirror 35 and 37 is measured.

And the measurement value of these double pass interferometers is supplied to the stage control device 38 of drawing 1 , and the location of Y shaft orientations of a reticle stage RST is measured based on the average value. The information on this Y shaft-orientations location is used for the reticle of calculation of the relative position of the reticle stage RST and the wafer stages WS and WS 1 2 based on the measurement value of an interferometer which has length measurement shaft BI3Y by the side of a wafer, and the scanning direction at the time of the scan exposure based on this (Y shaft orientations), and the synchronousr control of a wafer.

[0091] On the other hand, the cube-corner-reflector mirrors 35 and 37 of a pair are installed in the side (space near side in drawing 1) besides Y shaft orientations which are scanning directions (the scanning direction) of a reticle stage RST. As opposed to the double pass interferometer of a non-illustrated pair to these cube-corner-reflector mirrors 35 and 37 to drawing 2 And length measurement shaft BI7Y, The interferometer beam shown by BI8Y is irradiated, and it is returned to the reflector on the reticle base board 32 from the cube-corner-reflector mirrors 35 and 37. Then, each reflected reflected light is received with the double pass interferometer of each return in the same optical path, and the relative displacement from the criteria location (it is a reflector on said reticle base board 32 at a reference position) of each cube-corner-reflector mirror 35 and 37 is measured. And the measurement value of these double pass interferometers is supplied to the stage control device 38 of drawing 1 , and the location of Y shaft orientations of a reticle stage RST is measured based on the average value. The information on this Y shaft-orientations location is used for the reticle of calculation of the relative position of the reticle stage RST and the wafer stages WS and WS 1 2 based on the measurement value of an interferometer which has length measurement shaft BI3Y by the side of a wafer, and the scanning direction at the time of the scan exposure based on this (Y shaft orientations), and the synchronousr control of a wafer.

[0092] That is, reticle interferometer systems are constituted from this operation gestalt by the double pass interferometer of a pair shown by the interferometer 36 and length measurement shaft BI7Y, and BI8Y.

[0093] Next, the interferometer systems which manage the location of the wafer stages WST1 and WST2 are explained, referring to drawing 1 thru/or drawing 3 .

[0094] As shown in these drawings, the projection core and alignment system 24a of projection optics PL, The 1st shaft (X-axis) passing through each detection core of 24b is met. In the field by the side of the X shaft orientations 1 of the wafer stage WS 1 The interferometer beam shown by 1st length measurement shaft BI1X from the interferometer 16 of drawing 1 is irradiated, and the interferometer beam shown by 2nd length measurement shaft BI2X from the interferometer 18 of drawing 1 is similarly irradiated by the field of a side besides X shaft orientations of the wafer stage WS 2 in accordance with the 1st shaft. And in interferometers 16 and 18, by receiving these reflected lights, the relative displacement from the criteria location of each reflector is measured, and X shaft-orientations location of the wafer stages WS1 and WS2 is measured. Here, as shown in drawing 2 , interferometers 16 and 18 are 3 shaft interferometers which have three opticals axis each, and tilt measurement and theta measurement are possible for them in addition to measurement of X shaft orientations of the wafer stages WS1 and WS2. The output value of each optical axis can be independently measured now. Here, since Z and the leveling stage which is not illustrated [which performs a minute drive and inclination drive of theta stage which is not illustrated / which performs theta rotation of the wafer stages WS1 and WS2 /, and Z shaft orientations] are under a reflector in fact, it can act as the monitor of all the amounts of drives at the time of tilt control of a wafer stage with these interferometers 16 and 18.

[0095] In addition, each interferometer beam of 1st length measurement shaft BI1X and 2nd length measurement shaft BI2X The wafer stages WS1 and WS2 are always hit [therefore] throughout the successive range of the wafer stages WS1 and WS2. About X shaft orientations The location of the wafer stages WS1 and WS2 is managed also based on the measurement value of 1st length measurement shaft BI1X and 2nd length measurement shaft BI2X or the times of any, such as the time of use of the alignment systems 24a and 24b, at the time of the exposure using projection optics PL.

[0096] Moreover, the interferometer which has 3rd length measurement shaft BI3Y which crosses at right angles to the 1st shaft (X-axis) focusing on projection of projection optics PL as shown in

drawing 2 and drawing 3 , The interferometer which has length measurement shaft BI4Y as the 4th length measurement shaft which intersects the 1st shaft (X-axis) at a perpendicular focusing on each detection of the alignment systems 24a and 24b, respectively, and BI5Y, respectively is formed (however, only the length measurement shaft is illustrated all over drawing).

[0097] In the case of this operation gestalt, for the direction location measurement of Y of the wafer stages WS1 and WS2 at the time of the exposure using projection optics PL The measurement value based on [of projection optics] projection (i.e., the interferometer of length measurement shaft BI3Y which passes an optical axis AX) is used. For the direction location measurement of Y of the wafer stage WS 1 at the time of use of alignment system 24a The detection core of alignment system 24a, i.e., the measurement value of length measurement shaft BI4Y which passes an optical axis SX, is used. For the direction location measurement of Y of the wafer stage WS 2 at the time of alignment system 24b use The detection core of alignment system 24b, i.e., the measurement value of length measurement shaft BI5Y which passes an optical axis SX, is used.

[0098] Therefore, according to each service condition, although the interferometer length measurement shaft of Y shaft orientations will separate from the reflector of the wafer stages WS1 and WS2, since it does not separate from at least one length measurement shaft, i.e., length measurement shaft BI1X, and BI2X from the reflector of each wafer stage WS1 and WS2, the interferometer optical axis to be used can reset the interferometer by the side of Y in the proper location which entered on the reflector. The reset approach of this interferometer is explained in full detail behind.

[0099] In addition, each interferometer of length measurement shaft BI3Y for the above-mentioned Y measurement, BI4Y, and BI5Y is a biaxial interferometer which has two opticals axis each, and tilt measurement is possible for it in addition to measurement of Y shaft orientations of the wafer stages WS1 and WS2. [0100] which has been alike and become so that the output value of each optical axis can be measured independently The interferometer systems which manage the two-dimensional coordinate location of the wafer stages WS1 and WS2 are constituted from this operation gestalt by a total of five interferometers of three interferometers which have interferometers 16 and 18 and length measurement shaft BI3Y, BI4Y, and BI5Y.

[0101] Moreover, with this operation gestalt, while one side of the wafer stages WS1 and WS2 is performing the exposure sequence, another side performs wafer exchange and a wafer alignment sequence, so that it may mention later, but based on the output value of each interferometer, migration of the wafer stages WS1 and WS2 is managed by the stage control device 38 according to the command of a main control unit 90 so that there may be no interference of both stages in this case.

[0102] Next, an illumination system is explained based on drawing 1 . This illumination system consists of the exposure light source 40, a shutter 42, a mirror 44, the beam expanders 46 and 48, the 1st fly eye lens 50, a lens 52, the oscillating mirror 54, a lens 56, the 2nd fly eye lens 58, a lens 60, the fixed blind 62, a movable blind 64, a relay lens 66, and 68 grades, as shown in drawing 1 .

[0103] Here, above-mentioned each part of a configuration of this illumination system is explained with that operation.

[0104] After the laser beam injected from the light source section 40 which consists of KrF excimer laser which is the light source, and extinction systems (an extinction plate, aperture diaphragm, etc.) penetrates a shutter 42, a mirror 44 deviates, it is orthopedically operated by the suitable beam diameter with the beam expanders 46 and 48, and incidence of it is carried out to the 1st fly eye lens 50. The flux of light by which incidence was carried out to this 1st fly eye lens 50 is divided into two or more flux of lights by the element of the fly eye lens arranged two-dimensional, and incidence is carried out to the 2nd fly eye lens 58 from the include angle from which each flux of light differed again with the lens 52, the oscillating mirror 54, and the lens 56. The flux of light injected from this 2nd fly eye lens 58 With a lens 60, the fixed blind 62 installed in Reticle R and the location [****] is reached. After the cross-section configuration is specified in a predetermined configuration here, the movable blind 64 arranged in the location slightly defocused from the conjugation side of Reticle R is passed, and it passes through relay lenses 66 and 68. As uniform illumination light The rectangle slit-like lighting field IA (refer to drawing 2) is illuminated here [the predetermined configuration and here] where it was specified with the above-mentioned fixed blind 62 on Reticle

R.

[0105] Next, a control system is explained based on drawing 1 . This control system consists of the light exposure control devices 70 and stage control-device 38 grades which the subordinate of this main control unit 90 has centering on the main control unit 90 as a control means which controls the whole equipment in generalization.

[0106] Here, the actuation at the time of exposure of the projection aligner 10 applied to this operation gestalt focusing on actuation of above-mentioned each part of a configuration of a control system is explained.

[0107] Direct the light exposure control device 70 to the shutter driving gear 72, it makes the shutter mechanical component 74 drive, before a synchronous scan with Reticle R and a wafer (W1 or W2) is started, and opens a shutter 42.

[0108] Then, according to directions of a main control unit 90, the synchronous scan (scanning control) of Reticle R, Wafer (W1 or W2) RST, i.e., a reticle stage, and a wafer stage (WS1 or WS2) is started by the stage control device 38. This synchronous scan is performed by controlling each linear motor which constitutes the drive system of the reticle mechanical component 30 and a wafer stage by the stage control device 38, carrying out the monitor of the measurement value of length measurement shaft BI6X to length measurement shaft BI7Y of length measurement shaft BI3Y of the interferometer systems mentioned above, length measurement shaft BI1X or BI2X, and reticle interferometer systems, and BI8Y.

[0109] And when uniform control of both the stages is carried out within a predetermined allowable error, it directs to the laser control unit 76, and pulse luminescence is made to start in the light exposure control unit 70. The lighting field IA of said rectangle of the reticle R by which the chromium vacuum evaporationo of the pattern was carried out is illuminated by this by the illumination light from an illumination system on the inferior surface of tongue, the image of the pattern in the lighting field is reduced by projection optics PL by 1/5 time, and projection exposure is carried out on the wafer (W1 or W2) with which the photoresist was applied to the front face. Here, compared with the pattern space on a reticle, the slit width of the scanning direction of the lighting field IA is narrow, it is carrying out the synchronous scan of Reticle R and the wafer (W1 or W2) as mentioned above, and sequential formation of the image of the whole surface of a pattern is carried out to the shot field on a wafer so that clearly also from drawing 2 .

[0110] Here to the initiation and coincidence of pulse luminescence which were mentioned above the light exposure control unit 70 Until direct to the mirror driving gear 78, it makes the oscillating mirror 54 drive and the pattern space on Reticle R passes through the lighting field IA (refer to drawing 2) completely That is, nonuniformity reduction of the interference fringe generated by two fly eye lenses 50 and 58 by performing this control continuously is performed until the image of the whole surface of a pattern is formed in the shot field on a wafer.

[0111] Moreover, synchronizing with Reticle R and the scan of Wafer W, drive control of the movable blind 64 is carried out by the blind control device 39, and such synchronous operation of a series of is managed by the stage control device 38 so that the illumination light may not leak during the above-mentioned scan exposure outside the protection-from-light field on the reticle in the shot edge section.

[0112] By the way, since it is necessary to carry out luminescence of the pulse luminescence by the laser control unit 76 mentioned above n times (for n to be a positive integer) while the point of the arbitration on a wafer W1 and W2 passes lighting field width (w), if it sets an oscillation frequency to f and wafer scan speed is set to V, it needs to fill a degree type (2).

[0113] $f/n=V/w$ .... (2)

Moreover, if exposure energy of one pulse irradiated on a wafer is set to P and resist sensibility is set to E, it is necessary to fill a degree type (3).

[0114] $nP=E$ .... (3)

Thus, the light exposure control unit 70 calculates all about the good variate of the exposure energy P and the oscillation frequency f, and by controlling the extinction system which issued the command to the laser control unit 76, and was formed in the exposure light source 40, it carries out adjustable [of the exposure energy P and the oscillation frequency f], or it is constituted so that the shutter driving gear 72 and the mirror driving gear 78 may be controlled.

[0115] Furthermore, in a main control unit 90, when, amending the migration starting position (synchronous location) of a reticle stage and a wafer stage which performs a synchronous scan at the time of scanning exposure for example, amendment of the stage location according to the amount of amendments is directed to the stage control device 38 which carries out migration control of each stage.
[0116] Furthermore, in the projection aligner of this operation gestalt, the 1st carrier system for which a wafer is exchanged between the wafer stages WS 1, and the 2nd carrier system which performs wafer exchange between the wafer stages WS 2 are formed.
[0117] As are shown in drawing 7 , and the 1st carrier system is later mentioned between the wafer stages WS 1 in a left-hand side wafer loading location, it performs wafer exchange. This 1st carrier system The 1st unload arm 184 attached in the 1st loading guide 182 prolonged in Y shaft orientations, the 1st slider 186 which moves along with this loading guide 182 and the 2nd slider 190, and the 1st slider 186, It consists of the 1st wafer loader constituted including the 1st load arm 188 grade attached in the 2nd slider 190, and the 1st pin center,large rise 180 which consists of three vertical-movement members prepared on the wafer stage WS 1.
[0118] Here, actuation of the wafer exchange by this 1st carrier system is explained briefly.
[0119] Here, as shown in drawing 7 , the case where it is exchanged in wafer W1' on the wafer stage WS 1 in a left-hand side wafer loading location and the wafer W1 conveyed by the 1st wafer loader is explained.
[0120] First, in a main control unit 90, the vacuum of the wafer holder which is not illustrated on the wafer stage WS 1 is turned off through a non-illustrated switch, and adsorption of wafer W1' is canceled.
[0121] Next, in a main control unit 90, the specified quantity rise drive of the pin center,large rise 180 is carried out through a non-illustrated pin center,large rise drive system. Thereby, wafer W1' is raised to a predetermined location. In this condition, migration of the 1st unload arm 184 is supported to a non-illustrated wafer loader control unit with a main control unit 90. By this, drive control of the 1st slider 186 is carried out by the wafer loader control unit, the 1st unload arm 184 moves onto the wafer stage WS 1 along with the loading guide 182, and it is located just under wafer W1'.
[0122] In this condition, the downward drive of the pin center,large rise 180 is carried out to a predetermined location with a main control unit 90. Since wafer W1' is received and passed to the 1st unload arm 184 in the middle of descent of this pin center,large rise 180, in a main control unit 90, vacuum initiation of the 1st unload arm 184 is directed to a wafer loader control device. Thereby, adsorption maintenance of wafer W1' is carried out at the 1st unload arm 184.
[0123] Next, in a main control unit 90, evacuation of the 1st unload arm 184 and migration initiation of the 1st load arm 188 are directed to a wafer loader control unit. The 2nd slider 190 starts migration in the direction of +Y in one with the 1st load arm 188 holding a wafer W1 at the same time the 1st unload arm 184 starts migration in the direction of -Y of drawing 7 in one with the 1st slider 186 by this. And when the 1st load arm 188 comes above the wafer stage WS 1, while the 2nd slider 190 is stopped by the wafer loader control unit, the vacuum of the 1st load arm 188 is canceled.
[0124] The rise drive of the pin center,large rise 180 is carried out, and a wafer W1 is made to be lifted from a lower part by the pin center,large rise 180 in a main control unit 90 in this condition. Subsequently, in a main control unit 90, evacuation of a load arm is directed to a wafer loader control unit. The 2nd slider 190 starts migration in the direction of -Y in one with the 1st load arm 188 by this, and evacuation of the 1st load arm 188 is performed. With a main control unit 90, start the downward drive of the pin center,large rise 180, the wafer holder which is not illustrated on the wafer stage WS 1 is made to lay a wafer W1, and the vacuum of the wafer holder concerned is turned ON at evacuation initiation and coincidence of this 1st load arm 188. Thereby, a series of sequences of wafer exchange are completed.
[0125] Similarly, the 2nd carrier system performs wafer exchange like **** between the wafer stages WS 2 in a right-hand side wafer loading location, as shown in drawing 8 . This 2nd carrier system The 2nd unload arm 194 attached in the 3rd slider 196 which moves along with the 2nd loading guide 192 prolonged in Y shaft orientations, and this 2nd loading guide 192 and the 4th

slider 200, and the 3rd slider 196, It consists of the 2nd wafer loader constituted including the 2nd load arm 198 grade attached in the 4th slider 200, and the 2nd pin center,large rise of un-illustrating [which was prepared on the wafer stage WS 2].
[0126] Next, based on drawing 7 and drawing 8 , parallel processing by two wafer stages which are the descriptions of this operation gestalt is explained.
[0127] The top view in the condition that exchange of a wafer is performed between the wafer stage WS 1 and the 1st carrier system as mentioned above in the wafer W2 on the wafer stage WS 2 in the left-hand side loading location while performing exposure actuation through projection optics PL is shown in drawing 7 . In this case, on the wafer stage WS 1, as it mentions later succeedingly to wafer exchange, alignment actuation is performed. In addition, in drawing 7 , position control of the wafer stage WS 2 under exposure actuation is performed based on the measurement value of length measurement shaft BI2X of interferometer systems, and BI3Y, and wafer exchange and position control of the wafer stage WS 1 where alignment actuation is performed are performed based on the measurement value of length measurement shaft BI1X of interferometer systems, and BI4Y.
[0128] In the loading location of the left-hand side shown in this drawing 7 , it is the arrangement by which the reference mark on the reference mark plate FM 1 of the wafer stage WS 1 comes just under alignment system 24a (refer to drawing 9 (A)). For this reason, in the main control unit 90, before alignment system 24a detects the reference mark MK2 on the reference mark plate FM 1, reset of the interferometer of length measurement shaft BI4Y of interferometer systems is performed.

[0129] The situation of image incorporation which detects an example of the configuration of a reference mark MK2 and it by the FIA system sensor of alignment system 24a is shown in drawing 9 (B). In this drawing 9 (B), the cross-joint-like mark which Sign Sx shows the image incorporation range of CCD, and is shown with Sign M is an index in a FIA system sensor. Here, although only the image incorporation range of X shaft orientations is shown, of course, the image incorporation with the same said of Y shaft orientations is performed in fact.
[0130] When the image of the mark MK2 of drawing 9 (B) is captured by the sensor of a FIA system, the wave signal acquired by the image-processing system in the alignment control unit 80 is shown in drawing 9 (C). The location of the mark MK2 on the basis of an index core is detected in analyzing this wave signal in the alignment control unit 80. In a main control unit 90 Based on the location of said mark MK2, and length measurement shaft BI1X and the measurement result of the interferometer of BI4Y, the coordinate location of the mark MK2 on the reference mark plate FM 1 in the system of coordinates (suitably henceforth "the 1st stage system of coordinates") using length measurement shaft BI1X and BI4Y is computed.
[0131] It continues at the wafer exchange mentioned above and reset of an interferometer, and search alignment is performed. Only in PURIARAIMENTO made during conveyance of a wafer W1, since the position error is large, the search alignment performed after the wafer exchange is PURIARAIMENTO again performed on the wafer stage WS 1. The location of three search alignment marks (not shown) specifically formed on the wafer W1 laid on the stage WS 1 is measured using the sensor of the LSA system of alignment system 24a etc., and alignment of X of a wafer W1, Y, and the direction of theta is performed based on the measurement result. Actuation of each part in the case of this search alignment is controlled by the main control unit 90.
[0132] Fine alignment which searches for the array of each shot field on a wafer W1 here using EGA is performed after termination of this search alignment. Specifically by interferometer systems (length measurement shaft BI1X, BI4Y) Carrying out sequential migration of the wafer stage WS 1 based on the shot array data on a design (alignment mark location data) managing the location of the wafer stage WS 1 The alignment mark location of the predetermined sample shot on a wafer W1 is measured by the sensor of the FIA system of alignment system 24a etc., and all shot array data are calculated by the statistics operation by the least square method based on the design coordinate data of this measurement result and a shot array. Thereby, the coordinate location of each shot is computed on the above-mentioned 1st stage system of coordinates. In addition, actuation of each part in the case of this EGA is controlled by the main control unit 90, and the above-mentioned operation is performed by the main control unit 90.
[0133] And with a main control unit 90, the relative-position relation of each shot to a mark MK2 is

computed by subtracting the coordinate location of a reference mark MK2 mentioned above from the coordinate location of each shot.

[0134] Location measurement of an alignment mark is performed, performing the automatic focus / auto leveling by measurement of the same AF/AL system 132 (refer to drawing 4) as the time of exposure, and control at the time of measurement by alignment system 24a, as mentioned above, and it can avoid producing the offset (error) by the posture of a stage between the times of alignment and exposure in the case of this operation gestalt.

[0135] At the wafer stage WS 1 side, while the above-mentioned wafer exchange and alignment actuation are performed, by the wafer stage WS 2 side, the reticles R1 and R2 of two sheets as shown in drawing 12 are used, and double exposure is continuously performed by step - and - scanning method, changing exposure conditions.

[0136] Relative-position-related calculation of each shot to a mark MK2 is specifically beforehand performed like the wafer W1 side mentioned above. This result, It is based on the result of relative-position detection (this is explained in full detail behind) of the wafer side top projection image of the marks MK1 and MK3 on the criteria arc plate FM 1 under the reticle alignment microscopes 144 and 142, and the marks RMK1 and RMK3 corresponding to it on a reticle. Scanning exposure is performed by making a scanning direction carry out the synchronous scan of a reticle stage RST and the wafer stage WS 2 at every exposure of each shot field, carrying out sequential positioning of the shot field on a wafer W2 at the optical-axis lower part of projection optics PL.

[0137] The exposure to all the shot fields on such a wafer W2 continues also after reticle exchange, and is performed. As exposure sequence of concrete double exposure, as shown in drawing 13 (A) After performing sequential scan exposure for each shot field of a wafer W1 to A1-A12 using a reticle R2 (A pattern), In order of B1-B12 which are shown in drawing 13 (B), scanning exposure is performed, after carrying out specified quantity migration of the reticle stage RST in a scanning direction using a drive system 30 and setting a reticle R1 (B pattern) as an exposure location. Since a reticle R2 differs in exposure conditions (AF/AL, light exposure) or transmission from a reticle R1 at this time, it is necessary to measure each condition at the time of reticle alignment, and to change conditions according to that result.

[0138] Actuation of each part in the double exposure of this wafer W2 is also controlled by the main control unit 90.

[0139] When the direction of the wafer stage ended previously will be in a waiting state and both actuation ends the exposure sequence, and the wafer exchange and the alignment sequence which are performed in parallel on two wafer stages WS [WS1 and] 2 shown in drawing 7 mentioned above, migration control of the wafer stages WS1 and WS2 is carried out to the location shown in drawing 8 . And as for the wafer W1 on the wafer stage WS 1 where wafer exchange was made by the right-hand side loading position, and the alignment sequence ended the wafer W2 on the wafer stage WS 2 which the exposure sequence ended, an exposure sequence is performed under projection optics PL.

[0140] By the right-hand side loading position shown in drawing 8 , the reference mark MK2 on the reference mark plate FM 2 will be positioned in the bottom of alignment system 24b as well as a left-hand side loading position, and the above-mentioned wafer exchange actuation and an alignment sequence will be performed. Of course, the reset action of the interferometer which has length measurement shaft BI5Y of interferometer systems is performed in advance of detection of the mark MK2 on the reference mark plate FM 2 by alignment system 24b.

[0141] Next, the reset action of the interferometer by the main control unit 90 at the time of shifting to the condition of drawing 8 from the condition of drawing 7 is explained.

[0142] Although the wafer stage WS 1 is moved to the location (refer to drawing 10 (A)) to which the reference mark on the reference mark plate FM 1 comes just under the optical-axis AX core (projection core) of the projection optics PL shown in drawing 8 after it performs alignment by the left-hand side loading position Since incidence of the interferometer beam of length measurement shaft BI4Y will not be carried out to the reflector 21 of the wafer stage WS 1 in the middle of this migration, it is difficult to move the wafer stage WS 1 to the location of drawing 8 immediately after alignment termination. For this reason, the following works are carried out with this operation gestalt.

[0143] Namely, as explained previously, when the wafer stage WS 1 is located into a left-hand side

loading position with this operation gestalt Since it is set up so that the reference mark plate FM 1 may come just under alignment system 24a, and the interferometer of length measurement shaft BI4Y is reset in this location Once return the wafer stage WS 1 to this location, and it is based on the distance (referred to as BL for convenience) of the detection core of alignment system 24a and the optical-axis core (projection core) of projection optics PL which are beforehand known from that location. Only distance BL moves the wafer stage WS 1 to X shaft-orientations right-hand side, carrying out the monitor of the measurement value of the interferometer 16 of length measurement shaft BI1X with which an interferometer beam does not go out. By this, the wafer stage WS 1 will be moved to the location shown in drawing 8 .

[0144] And in a main control unit 90, as shown in drawing 10 (A), the reticle alignment microscopes 144 and 142 perform relative-position detection of the wafer side top projection image of the marks MK1 and MK3 on the reference mark plate FM 1, and the marks RMK1 and RMK3 corresponding to it on a reticle using exposure light.

[0145] The wafer side top projection image of the mark RMK (RMK1, RMK2) on Reticle R is shown in drawing 10 (B), and the mark MK (MK1, MK3) on a reference mark plate is shown in drawing (C). Moreover, the situation of image incorporation which detects the mark MK (MK1, MK3) on the wafer side top projection image of the mark RMK (RMK1, RMK2) on Reticle R and a reference mark plate to coincidence is shown in the reticle alignment microscopes 144 and 142 in the state of drawing 10 (A) at drawing 10 (D). In this drawing 10 (D), Sign SRx shows the image incorporation range of CCD which constitutes a reticle alignment microscope. The wave signal with which it might be processed by the image-processing system whose image captured above is not illustrated is shown in drawing 10 (E).

[0146] In a main control unit 90, before incorporating this wave signal wave form, the interferometer of length measurement shaft BI3Y is reset. A reset action can be performed when the length measurement shaft used for a degree can irradiate a wafer stage side face.

[0147] The coordinate location of the marks MK1 and MK3 on the reference mark plate FM 1 in system of coordinates (2nd stage system of coordinates) using length measurement shaft BI1X and BI3Y by this, The wafer side top projection image coordinate location of the mark RMK on reticle R will be detected, and the relative-position relation between an exposure location (projection core of projection optics PL), and the mark MK1 on the reference mark plate FM 1 and MK3 coordinate location is called for according to both difference.

[0148] And more finally than the relative-position relation of each shot to the mark MK2 on the orientation plate FM 1 for which it asked previously, and the relative relation between an exposure location, and the mark MK1 on an orientation plate FM 1 and MK3 coordinate location in a main control unit 90, an exposure location and the relative-position relation of each shot are computed. According to the result, as shown in drawing 11 , exposure of each shot on a wafer W1 will be performed.

[0149] As mentioned above, even if it performs the reset action of an interferometer, the reason in which high precision alignment is possible is because spacing of a reference mark and the virtual location computed by measurement of a wafer mark is computed by the same sensor by measuring the alignment mark of each shot field on a wafer W1, after measuring the reference mark on the reference mark plate FM 1 by alignment system 24a. It is because highly precise exposure actuation can be performed even if the interferometer beam of the interferometer of Y shaft orientations will go out during migration of a wafer stage and will reset again by adding said relative distance to that value, if correspondence with an exposure location and a reference mark location has been taken under the reticle alignment microscopes 142 and 144 before exposure since a reference mark and the relative-position relation (relative distance) of the location which should be exposed are called for at this time.

[0150] In addition, since reference marks MK1-MK3 are on the always same orientation plate, if the drawing error is searched for beforehand, there will be no fluctuation factor only at offset management. Moreover, although RMK1 and RMK2 may have the offset by the reticle drawing error, if two or more marks are used at the time of reticle alignment, and a drawing error is mitigated or the reticle mark drawing error is beforehand measured so that it may be indicated by the publication-number No. 67271 [five to] official report, for example, it can respond only by offset

management similarly.
[0151] Moreover, of course, the wafer stage WS 1 may be immediately moved linearly to the location of drawing 8 after alignment termination, carrying out the monitor of the measurement value of length measurement shaft BI1X and BI4Y, when length measurement shaft BI4Y does not go out, while the wafer stage WS 1 moves to the location of drawing 8 from an alignment termination location. In this case, it may be made to perform the reset action of an interferometer from relative-position detection of the wafer side top projection image of the marks MK1 and MK3 on the reference mark plate FM 1 under the reticle alignment microscopes 144 and 142, and the marks RMK1 and RMK3 corresponding to it on a reticle at which [former] time after the time of length measurement shaft BI3Y which passes along the optical axis AX of projection optics PL starting the reflector 21 which intersects perpendicularly with the Y-axis of the wafer stage WS 1.
[0152] What is necessary is to move the wafer stage WS 2 from an exposure termination location like the above to the loading position of the right-hand side shown in drawing 8 , and just to perform the reset action of the interferometer of length measurement shaft BI5Y.
[0153] Moreover, an example of the timing of the exposure sequence which carries out sequential exposure of each shot field on the wafer W1 held on the wafer stage WS 1 is shown in drawing 14 , and the timing of this and the alignment sequence on the wafer W2 held on the wafer stage WS 2 performed in juxtaposition is shown in drawing 15 . With this operation gestalt, improvement in a throughput is aimed at by performing an exposure sequence, and wafer exchange and an alignment sequence in parallel to the wafers W1 and W2 on each wafer stage, moving independently two wafer stages WS1 and WS2 in the two-dimensional direction.
[0154] However, when carrying out concurrent processing of two actuation using two wafer stages, the actuation performed on one wafer stage may affect the actuation to which it is carried out on the wafer stage of another side as a disturbance factor. Moreover, there is also actuation which does not affect the actuation to which actuation performed on one wafer stage is carried out conversely on the wafer stage of another side. So, with this operation gestalt, it divides into the actuation which causes disturbance among the actuation which carries out parallel processing, and the actuation not becoming, and timing adjustment of each actuation is achieved so that actuation leading to disturbance or actuation leading to disturbance may be performed to coincidence.
[0155] For example, during scanning exposure, since the synchronous scan of a wafer W1 and the reticle R is carried out at uniform velocity, when not becoming a disturbance factor, it is necessary to eliminate the disturbance factor of the from else as much as possible. For this reason, during the scanning exposure on one wafer stage WS 1, timing adjustment is made so that it may be in a quiescent state in the alignment sequence performed with the wafer W2 on the wafer stage WS 2 of another side. Namely, since mark measurement in an alignment sequence is performed in the condition of having made the wafer stage WS 2 standing it still in a mark location, for scanning exposure, it does not cause disturbance but can perform [be / it / under / scanning exposure / concurrency] mark measurement. The scanning exposure shown to a wafer W1 in drawing 15 by the number "1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23" of operation when this is seen by drawing 14 and drawing 15 , It turns out that mark measurement actuation in each alignment mark location shown to a wafer W2 in drawing 16 by the number "1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23" of operation is performed synchronizing with mutual. On the other hand, since it is uniform motion during scanning exposure also in an alignment sequence, it does not become disturbance but high precision measurement can be performed.
[0156] Moreover, it is possible to be the same at the time of wafer exchange. Since especially vibration produced in case a wafer is delivered to a pin center,large rise from a load arm can cause disturbance, according to the time of acceleration and deceleration before and after [before scanning exposure] coming to perform a synchronous scan at uniform velocity (it becomes a disturbance factor), it may be made to deliver a wafer.
[0157] Timing adjustment mentioned above is performed by the main control unit 90.
[0158] As explained above, according to the projection aligner 10 of this operation gestalt, two wafer stages WS1 and WS2 which hold two wafers independently, respectively are provided. While moving these two wafer stages independently of the XYZ direction and performing wafer exchange and alignment actuation on one wafer stage Since each other actuation was switched when we

decided to perform exposure actuation on the wafer stage of another side and both actuation was completed, it becomes possible to raise a throughput sharply.
[0159] moreover, from it having been made to perform the measurement sequence of the reference mark plate arranged on a wafer stage, while resetting the interferometer of the length measurement shaft used in the actuation after a switch, when switching the above-mentioned actuation The length measurement shaft of interferometer systems is the reflector (when forming a migration mirror independently) of a wafer stage. Since there is no un-arranging and it becomes possible to shorten the reflector (for it to be a migration mirror when forming a migration mirror independently) of a wafer stage especially even if it separates from this migration mirror The miniaturization of a wafer stage can be realized easily and die length of one side of a wafer stage can specifically be miniaturized even in the magnitude of slightly larger extent than a wafer diameter. In addition to becoming possible to include easily two wafer stages which can carry out movable independently by this in equipment, it becomes possible to raise the positioning engine performance of each wafer stage.
[0160] furthermore, about the wafer stage of the direction where exposure actuation is performed The reticle alignment microscopes 142 and 144 (exposure light alignment sensor) which minded [the interferometer reset for length measurement and] projection optics PL perform mark measurement on a reference mark plate. From our having decided to perform mark measurement on a reference mark plate to the interferometer reset for length measurement, and coincidence by alignment system 24a or 24b (off-axis alignment sensor) about the wafer stage of the direction where wafer exchange and alignment actuation are performed It becomes possible [switching the interferometer length measurement shaft which manages the location of a wafer stage] also in the case of exposure by the alignment by each alignment system, and projection optics. In this case, in case a mark on ** reference mark plate is measured in alignment system 24a or 24b Measure the coordinate location of this mark on the 1st stage system of coordinates, and detect the alignment mark of the sample shot on a wafer after that [**], and it is asked for the array coordinate (coordinate location for exposure) of each shot on the 1st stage system of coordinates by the EGA operation. ** Ask for the relative-position relation between a mark on a reference mark plate, and the coordinate location for exposure of each shot from the result of the above-mentioned ** and **. ** The reticle alignment microscopes 142 and 144 detect the relative-position relation between the mark on a reference mark plate, and a reticle projection coordinate location on the 2nd stage system of coordinates through projection optics PL before exposure. ** Since each shot is exposed using the above-mentioned ** and **, even if it switches the interferometer length measurement shaft which manages the location of a wafer stage, it can expose with high degree of accuracy. Consequently, without performing base-line measurement which measures the projection core of projection optics like the former, and spacing based on [of an alignment system] detection, the alignment of a wafer becomes possible and it becomes unnecessary [loading of a big reference mark plate which is indicated by the publication-number No. 176468 / seven to / official report].
[0161] Moreover, since at least two alignment systems which perform mark detection on both sides of projection optics PL are provided according to the above-mentioned operation gestalt, it becomes possible by shifting two wafer stages by turns to carry out parallel processing of the alignment actuation performed using alternation in each alignment system, and the exposure actuation.
[0162] Moreover, according to the above-mentioned operation gestalt, the neighborhood of an alignment system, and since it is arranged so that it can carry out especially in each alignment location, the shift to an alignment sequence from wafer exchange is performed smoothly, and the wafer loader which performs wafer exchange can obtain a higher throughput.
[0163] Furthermore, since a high throughput which was mentioned above is obtained according to the above-mentioned operation gestalt, even if it detaches the alignment system of an off-axis more greatly than projection optics PL and installs it, the effect of degradation of a throughput is almost lost. For this reason, it is high N.A. (numerical aperture) of a straight cylinder mold, and it becomes possible to design and install the small optical system of aberration.
[0164] Moreover, since it has the interferometer beam from the interferometer of each optical axis of two alignment systems and projection optics PL which measures a core mostly for every optical system according to the above-mentioned operation gestalt, It becomes possible to be able to

measure two wafer stage locations correctly in the condition that there is no ATSU ******, respectively in any [at the time of the pattern exposure through the time of alignment, or projection optics] case, and to move two wafer stages independently to it correctly.

[0165] Furthermore, length measurement shaft BI1X and BI2X which were prepared towards the projection core of projection optics PL along the direction (here X shaft orientations) where two wafer stages WS1 and WS2 are located in a line from both sides In order to always irradiate to the wafer stages WS1 and WS2 and to measure X shaft-orientations location of each wafer stage, it becomes possible to carry out migration control so that two wafer stages may not interfere mutually.

[0166] Moreover, according to the above-mentioned operation gestalt, since double exposure is performed using the reticle R of two or more sheets, the improvement effectiveness of high resolution and DOF (depth of focus) is acquired. In order to have to repeat an exposure process twice [at least], there was un-arranging [that the exposure time became long and a throughput fell sharply], but since a throughput can improve sharply by using the projection aligner of this operation gestalt, this double exposure method can acquire high resolution and the improvement effectiveness of DOF, without reducing a throughput.

[0167] For example, it sets to T1 (wafer swap time), T2 (search alignment time amount), T3 (fine alignment time amount), and T four (1 time of exposure time). Each processing time in a 8 inch wafer T 1:9 seconds, T 2:9 seconds, T 3:12 seconds, If double exposure is performed by the conventional aligner by which a series of processings are sequentially performed using one wafer stage when it considers as T 4:28 seconds It is set to 41 (at [the time of **/]). throughput THOR=3600-/(T1+T2+T3+T-four*2) =3600/(30+28*2) = -- Compared with the throughput (THOR=3600/(T1+T2+T3+T four) =3600 / 58= 62 (at [the time of **/])) of equipment, a throughput is downed to 66% conventionally which enforces the single exposing method using one wafer stage. since [on the other hand,] the exposure time is larger when performing double exposure, carrying out parallel processing of T1, T2 and T3, and the T four using the projection aligner of this operation gestalt -- throughput THOR=3600/(28+28) = -- it is set to 64 (at [the time of **/]), and it becomes possible to improve a throughput sharply, maintaining the improvement effectiveness of high resolution and DOF. Moreover, the exposure time becomes possible [increasing a long part and EGA mark], and alignment precision improves.

[0168] << -- 2nd operation gestalt>> -- next, the 2nd operation gestalt of this invention is explained based on drawing 16 and drawing 17 . Here, about a component the same as that of the 1st operation gestalt mentioned above, or equivalent, while using the same sign, the explanation shall be given simple or it shall omit.

[0169] As a projection aligner is shown in this 2nd operation gestalt at drawing 16 , die length of one side of the wafer stage WS 1 (die length of one side of WS2 is the same as this) Since it is longer than the mutual distance BL (a mutual distance of length measurement shaft BI5Y and BI3Y is the same as this) of length measurement shaft BI4Y and BI3Y, While the wafer stage WS 1 (or WS2) moves from the termination location of an alignment sequence to the starting position of an exposure sequence, it has the description at the point that length measurement beam BI4Y (or BI5Y) goes out from the reflector of a stage. For this reason, although the point which becomes measurable [the reference mark of a reference mark plate] after reset of an interferometer differs from the case of the 1st operation gestalt mentioned above so that it may mention later, the configuration of other parts etc. is the same as that of the projection aligner 10 of the 1st operation gestalt mentioned above.

[0170] After the alignment of the wafer stage WS 1 top wafer W1 is completed, signs that the interferometer of length measurement shaft BI3Y is reset are shown in drawing 16 .

[0171] Fine alignment (carried out by EGA mentioned above) actuation of the wafer W1 according [the interferometer of length measurement shaft BI1X which has managed the location of the wafer stage WS 1 so that clearly also from this drawing 16 , and BI4Y] to alignment system 24a or subsequent ones Since an interferometer beam does not separate from the reflector formed in Y shaft-orientations end side of the wafer stage WS 1 In a main control unit 90, the wafer stage WS 1 is moved to the location of drawing 16 where the reference mark plate FM 1 is positioned in the bottom of the projection lens PL from an ARAMENTO termination location, carrying out the monitor of the measurement value of the interferometer of length measurement shaft BI1X and BI4Y. Under the present circumstances, just before positioning the reference mark plate FM 1 just

under the projection lens PL, the interferometer beam of length measurement shaft BI3Y comes to be reflected in the reflector of the wafer stage WS 1.
[0172] In this case, unlike the case of the 1st operation gestalt mentioned above, since it is carried out based on the measurement value of the interferometer of length measurement shaft BI1X and BI4Y, with a main control unit 90, the position control of the wafer stage WS 1 has managed the location of the wafer stage WS 1 correctly, and it is it at this time (just before positioning the reference mark plate FM 1 just under the projection lens PL), and it resets the interferometer of length measurement shaft BI3Y. Position control of the wafer stage WS 1 comes (the change of system of coordinates is performed to the 2nd stage system of coordinates from the 1st stage system of coordinates) to be performed after reset termination based on the measurement value of the interferometer of length measurement shaft BI1X and BI3Y.
[0173] Then, the wafer stage WS 1 is positioned in the location shown in drawing 16 with a main control unit 90. Like the case of the 1st operation gestalt mentioned above using the reticle microscopes 142 and 144 Relative-position detection of the wafer side top projection image of the marks MK1 and MK3 on the reference mark plate FM 1, and the marks RMK1 and RMK3 corresponding to it using exposure light on a reticle, Namely, after detecting relative-position relation between marks RMK1 and RMK3 and an exposure location (projection core of projection optics PL), More finally than the relative-position relation between the relative-position relation of each shot to the mark MK2 on the reference mark plate FM 1 currently called for beforehand, an exposure location, and the mark MK1 on the reference mark plate FM 1 and MK3 coordinate location, an exposure location and the relative-position relation of each shot are computed. It exposes according to the result (refer to drawing 11). (double exposure mentioned above)
[0174] Although it separates from length measurement shaft BI4Y from a reflector according to an exposure location and becomes measurement impossible during this exposure, since the switch of the length measurement shaft for the position control of the wafer stage WS 1 has already been performed, there is no un-arranging.
[0175] Thus, while actuation of an exposure sequence is performed by one wafer stage WS 1 side, position control is made based on the measurement value of the interferometer of length measurement shaft BI2X and BI5Y, and, as for the wafer stage WS 2 of another side, W exchange sequence and the wafer alignment sequence are performed. In this case, in the wafer stage WS 1 side, since double exposure is performed like the above-mentioned, the direction of actuation of the wafer exchange sequence by the side of the wafer stage WS 2 and a wafer alignment sequence is completed previously, and the wafer stage WS 2 is in the standby condition after that.
[0176] When all exposure of a wafer W1 is completed, in a main control unit 90, carrying out the monitor of the measurement value of the interferometer of length measurement shaft BI1X and BI3Y, the interferometer beam of length measurement shaft BI4Y moves to the location reflected in the reflector of the wafer stage WS 1 on the wafer stage WS 1, and resets the interferometer of length measurement shaft BI4Y. After reset action termination, with a main control unit 90, the length measurement shaft for control of the wafer stage WS 1 is again switched to length measurement shaft BI1X and BI4Y, and the wafer stage WS 1 is moved to a loading position.
[0177] Although the interferometer beam of length measurement shaft BI3Y separates from a reflector and serves as measurement impossible shortly during this migration, since the switch of the length measurement shaft for the position control of the wafer stage WS 1 has already been performed, there is no un-arranging.
[0178] In a main control unit 90, migration of the wafer stage WS 2 is started in parallel to making it move towards the loading position of the wafer stage WS 1 that the reference mark plate FM 2 of the wafer stage WS 2 should be positioned down to projection optics PL. In the middle of this migration, like the above-mentioned, perform reset of the interferometer of length measurement shaft BI3Y, and it is made after that to be the same as that of the above-mentioned. Relative-position detection of the wafer side top projection image of the marks MK1 and MK3 on the reference mark plate FM 2, and the marks RMK1 and RMK3 corresponding to it using the reticle microscopes 142 and 144 on a reticle, Namely, after detecting relative-position relation between marks RMK1 and RMK3 and an exposure location (projection core of projection optics PL), More finally than the relative-position relation between the relative-position relation of each shot to the mark MK2 on the reference mark

plate FM 2 currently called for beforehand, an exposure location, and the mark MK1 on the reference mark plate FM 2 and MK3 coordinate location, an exposure location and the relative-position relation of each shot are computed. Exposure (double exposure mentioned above) is started according to the result.

[0179] It does in this way, the wafer stage WS 1 is moved to drawing 17 to a loading position, and the situation when actuation of an exposure sequence is performed by the wafer.stage WS 2 side is shown.

[0180] by this loading position, like the case of the 1st operation gestalt, the mark MK2 on the reference mark plate FM 1 positions, it is made the bottom of alignment system 24a, and a main control unit 90 detects the coordinate location of a mark MK2 like the case of the 1st operation gestalt on wafer exchange termination, simultaneously the 1st stage system of coordinates (BI1X, BI4Y). Next, EGA measurement is carried out to the mark on a wafer W1, and the coordinate location of each shot in the same system of coordinates is computed. Namely, the relative-position relation of each shot to a mark MK2 is computed by subtracting the coordinate location of the mark MK2 on an orientation plate FM 1 from the coordinate location of each shot. EGA actuation will be ended at this time, and it will wait for exposure termination of the wafer stage WS 2 top wafer W2, and will shift to the condition of drawing 16 again.

[0181] According to the projection aligner of the operation gestalt of **** 2 explained above, can acquire effectiveness equivalent to the 1st operation gestalt mentioned above, and also The length measurement shaft which switches in the middle of migration of the stage at the time of switching to actuation of an exposure sequence, and is used a front and after a switch, respectively is made to be reflected in the reflector of a wafer stage in coincidence after termination of an alignment sequence of operation. moreover, from the length measurement shaft which switches in the middle of migration of the stage at the time of switching to actuation of wafer exchange and an alignment sequence after termination of an exposure sequence of operation, and is used a front and after a switch, respectively having been made to be reflected in the reflector of a wafer stage in coincidence The exposure light alignment sensor (reticle alignment microscope 142,144) which minded projection optics PL after the interferometer reset for length measurement performs mark measurement on a reference mark plate. In advance of this, reset of the interferometer for length measurement is performed also in the case of wafer exchange, and it becomes possible to perform mark measurement on an orientation plate after wafer exchange termination by the off-axis alignment sensor (alignment systems 24a and 24b). Therefore, it becomes possible to switch the interferometer of stage control to the interferometer which has the length measurement shaft used in the actuation after a switch in the middle of a switch of the exposure actuation and wafer exchange actuation by projection optics PL in the middle of a switch with the alignment actuation by each alignment system, and the exposure actuation by projection optics PL. Therefore, it becomes possible to aim at improvement in a throughput further compared with the case of the 1st operation gestalt which was switching the length measurement shaft to the mark measurement on a reference mark plate, and coincidence.

[0182] In addition, although the above 1st and the 2nd operation gestalt explained the case where it was applied to the equipment with which this invention exposes a wafer using a double exposure method While the equipment of this invention performs exposure twice by one wafer stage side like the above-mentioned at the reticle of two sheets (double exposure), this When carrying out wafer exchange and wafer alignment in parallel by the wafer stage side of another side which can carry out movable independently, while a throughput higher than the conventional single exposure is obtained, it is because there is big effectiveness that large improvement in resolution can be aimed at, especially. However, also when the applicability of this invention is not limited to this and exposed by the single exposing method, this invention can be applied suitably. For example, supposing each processing time (T1 - T four) of a 8 inch wafer is the same as that of the above-mentioned If T1, T2, and T3 are made into one group (a total of 30 seconds) and T four (28 seconds) and parallel processing are performed when carrying out exposure processing by the single exposing method using two wafer stages like this invention the former which a throughput is set to THOR=3600 / 30= 120 (at [the time of **/]), and enforces the single exposing method using one wafer stage -- throughput THOR= of equipment -- it becomes possible to obtain an almost double high throughput

compared with 62 (at [the time of **/]).
[0183] Moreover, although the above-mentioned operation gestalt explained the case where step - and - scanning method performed scan exposure, even if it is at the electron ray aligner (EB aligner), X-ray aligner, and SUTITCHINGU exposure time which compounds a chip and a chip further when this invention is not limited to this and it performs quiescence exposure by the step-and-repeat method and, of course, it is applicable similarly.
[0184]
[Effect of the Invention] As explained above, according to invention given in claims 1-4, and 6-11, there is outstanding effectiveness which is not in the former that improvement in a throughput, and small and lightweight-izing of a substrate stage can be attained.
[0185] Moreover, according to invention according to claim 5, the projection exposure approach which can attain improvement in a throughput, and small and lightweight-izing of a stage is offered.

[Translation done.]

DESCRIPTION OF DRAWINGS

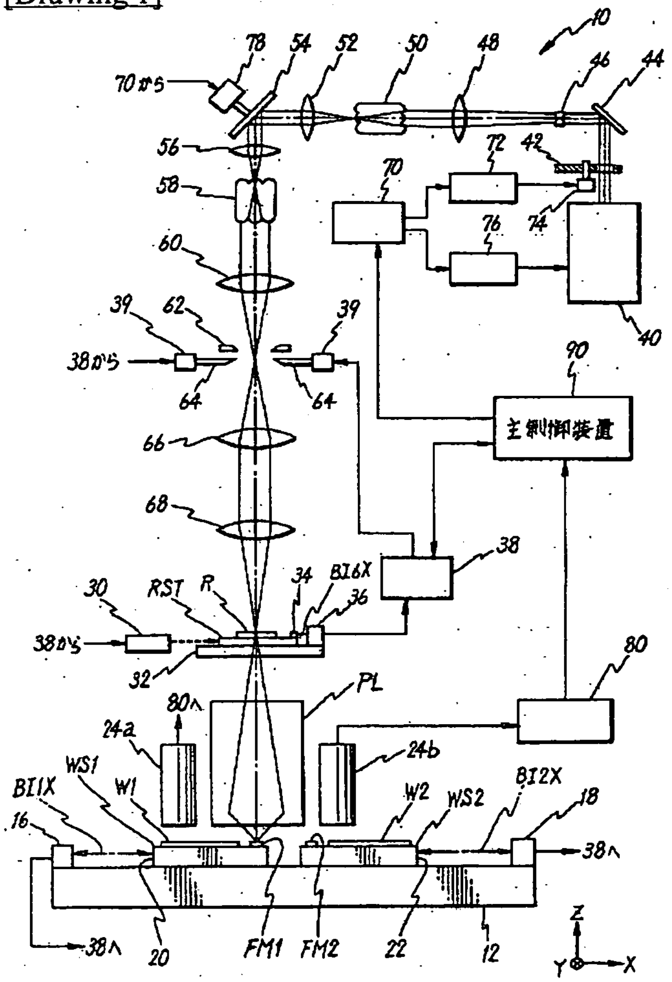
[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the outline configuration of the projection aligner concerning the 1st operation gestalt.
[Drawing 2] It is the perspective view showing the physical relationship of two wafer stages, reticle stages, projection optics, and alignment systems.
[Drawing 3] It is the top view showing the configuration of the drive of a wafer stage.
[Drawing 4] It is drawing showing the AF/AL system prepared in projection optics and an alignment system, respectively.
[Drawing 5] It is drawing showing the outline configuration of the projection aligner in which the configuration of an AF/AL system and a TTR alignment system is shown.
[Drawing 6] It is drawing showing the configuration of the pattern formation plate of drawing 5 .
[Drawing 7] It is the top view showing the condition that wafer exchange and the alignment sequence, and the exposure sequence are performed using two wafer stages.
[Drawing 8] It is drawing showing the condition of having performed the switch with wafer exchange and the alignment sequence of drawing 7 , and an exposure sequence.
[Drawing 9] It is drawing for explaining detection actuation of the reference mark on the reference mark plate by the alignment system. Drawing in which (A) shows signs that the reference mark MK2 on the reference mark plate FM 1 was positioned just under alignment system 24a, When drawing showing the signs of image incorporation that (B) detects an example of the configuration of a reference mark MK2 and it by the FIA system sensor of alignment system 24a, and (C) capture the image of a mark MK2 by the sensor of a FIA system, they are drawing showing the wave signal acquired by the image-processing system.
[Drawing 10] It is drawing for explaining measurement actuation of the mark under a reticle alignment microscope on a reference mark plate. Drawing showing signs that (A) is performing relative-position detection of the wafer side top projection image of the marks MK1 and MK3 on the reference mark plate FM 1, and the marks RMK1 and RMK3 corresponding to it on a reticle using exposure light under the reticle alignment microscope, Drawing in which (B) shows the wafer side top projection image of the mark RMK on Reticle R, drawing in which (C) shows the mark MK on a reference mark plate, drawing showing the situation of image incorporation [in / in (D) / (A)], and (E) are drawings showing the wave signal with which it might be processed in the captured image.
[Drawing 11] It is the conceptual diagram showing the condition that exposure of each shot on a wafer is performed according to the exposure location and the relative-position relation of each shot which were finally computed.
[Drawing 12] It is drawing showing the reticle stage holding the reticle of two sheets for double exposure.
[Drawing 13] It is drawing for explaining the exposure sequence in the case of double exposure, and (A) is drawing showing the exposure sequence at the time of exposing a wafer using the reticle of the pattern A of drawing 12 , and (B) is drawing showing the exposure sequence at the time of exposing a wafer using the reticle of the pattern B of drawing 12 .
[Drawing 14] It is drawing showing the exposure sequence for every shot field on the wafer held at one side of two wafer stages.
[Drawing 15] It is drawing showing the mark detection sequence for every shot field on the wafer

held on another side of two wafer stages.
[Drawing 16] It is drawing for explaining actuation of the 2nd operation gestalt, and after the alignment of the wafer stage WS 1 top wafer W1 is completed, it is drawing showing signs that the interferometer which has length measurement shaft BI3Y is reset.
[Drawing 17] It is drawing for explaining actuation of the 2nd operation gestalt, and is drawing showing a situation when the wafer stage WS 1 is moved to a loading position and actuation of an exposure sequence is performed by the wafer stage WS 2 side.
[Description of Notations]
10 Projection Aligner
24a, 24b Alignment system
90 Main Control Unit
142 144 Reticle alignment microscope
180 Pin Center,large Rise
182 1st Loading Guide
184 1st Unload Arm
186 1st Slider
188 1st Load Arm
190 2nd Slider
192 2nd Loading Guide
194 2nd Unload Arm
196 3rd Slider
198 2nd Load Arm
200 4th Slider
W1, W2 Wafer
WS1, WS2 Wafer stage
PL Projection optics
BI1X-BI5Y Length measurement shaft
R Reticle
MK1, MK2, MK3 Reference mark

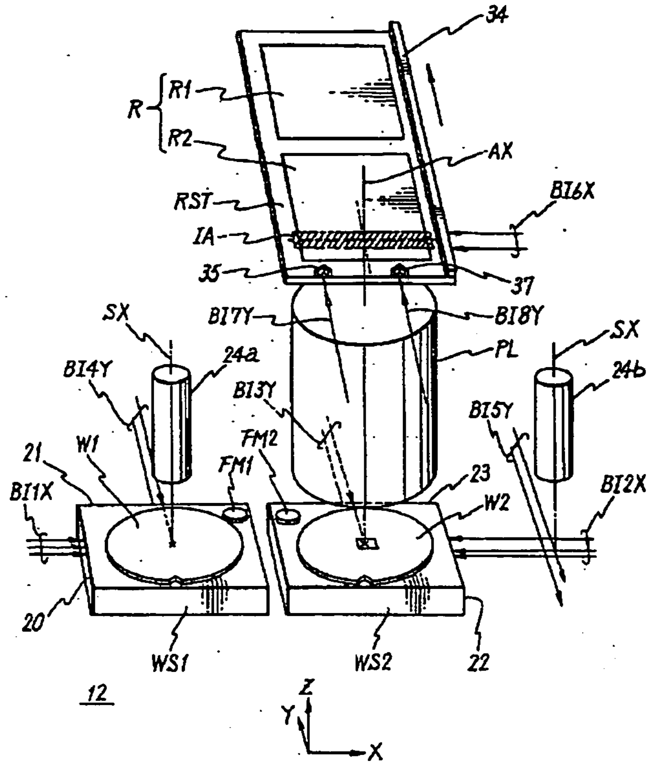
[Translation done.]

DRAWINGS

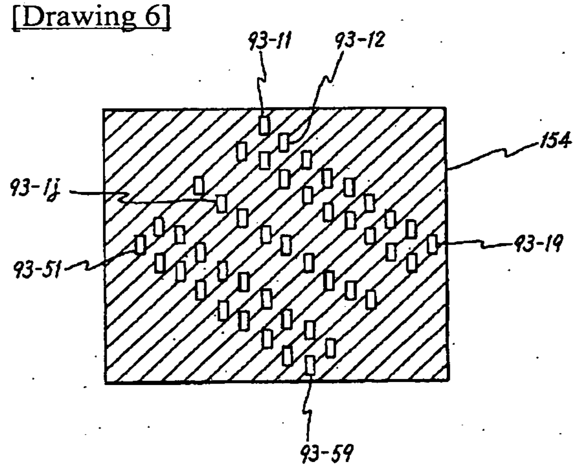
[Drawing 1]



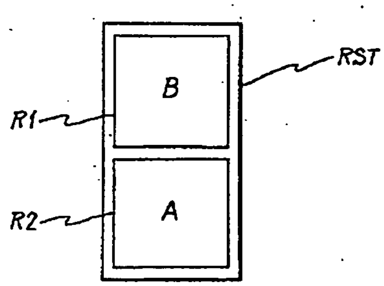
[Drawing 2]



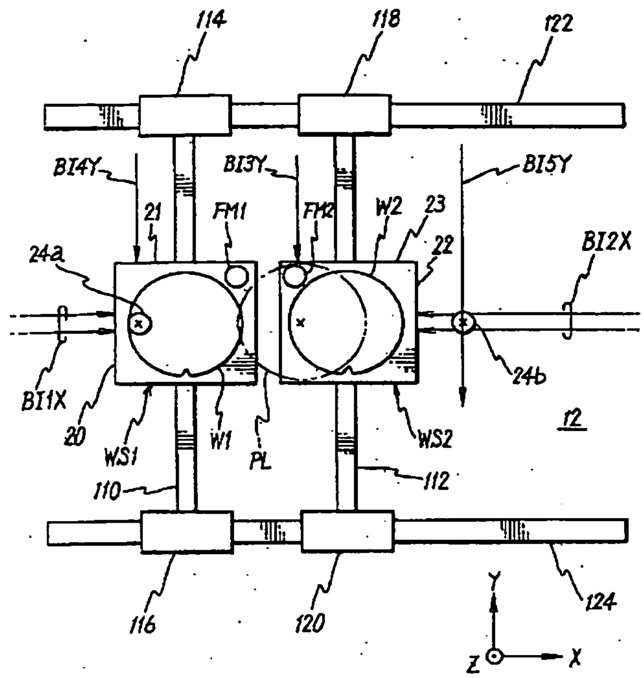
[Drawing 6]



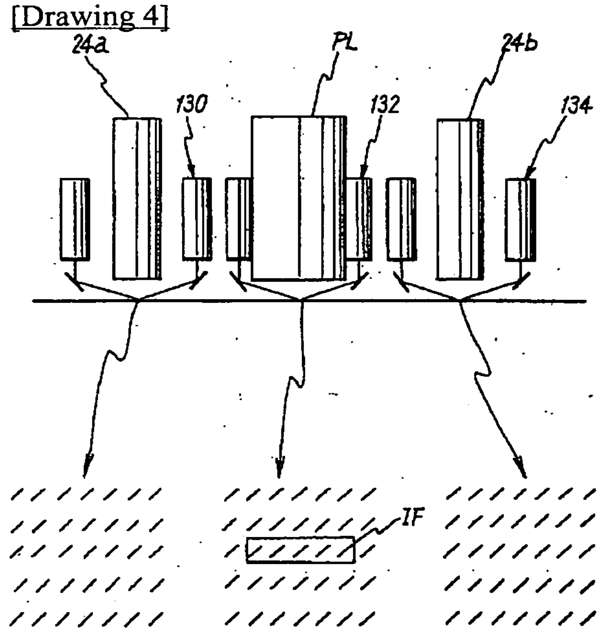
[Drawing 12]



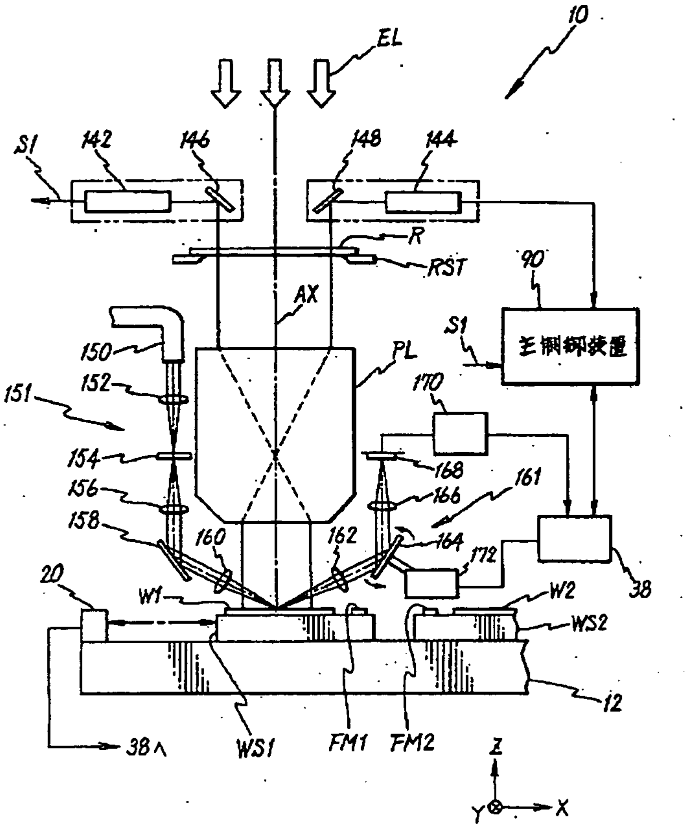
[Drawing 3]



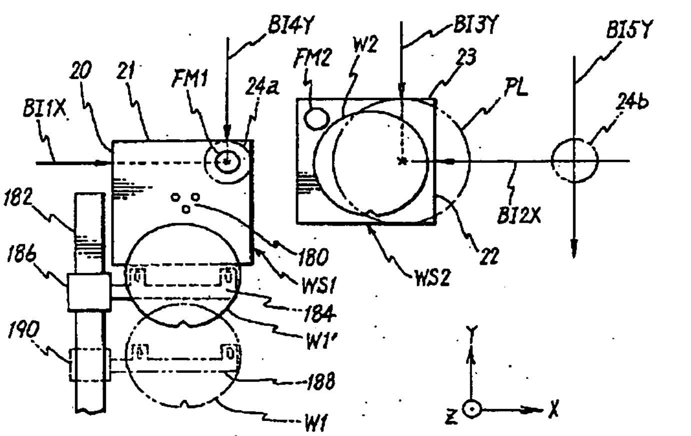
[Drawing 4]



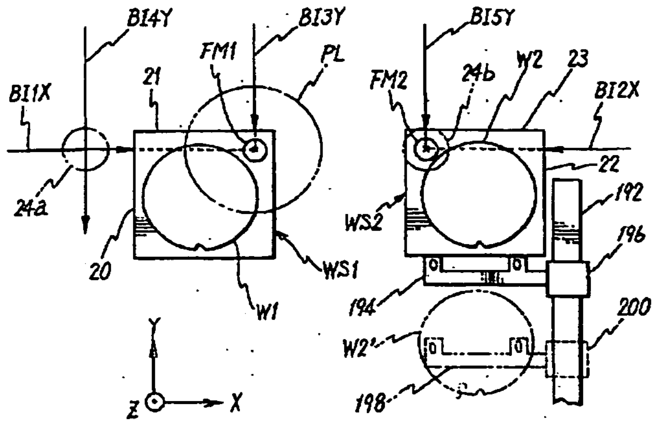
[Drawing 5]



[Drawing 7]

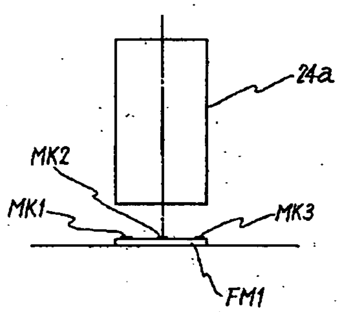


[Drawing 8]

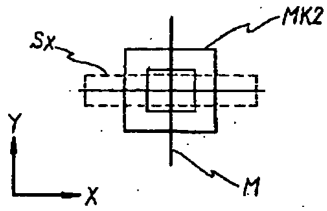


[Drawing 9]

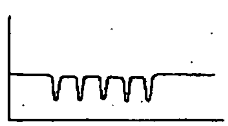
(A)



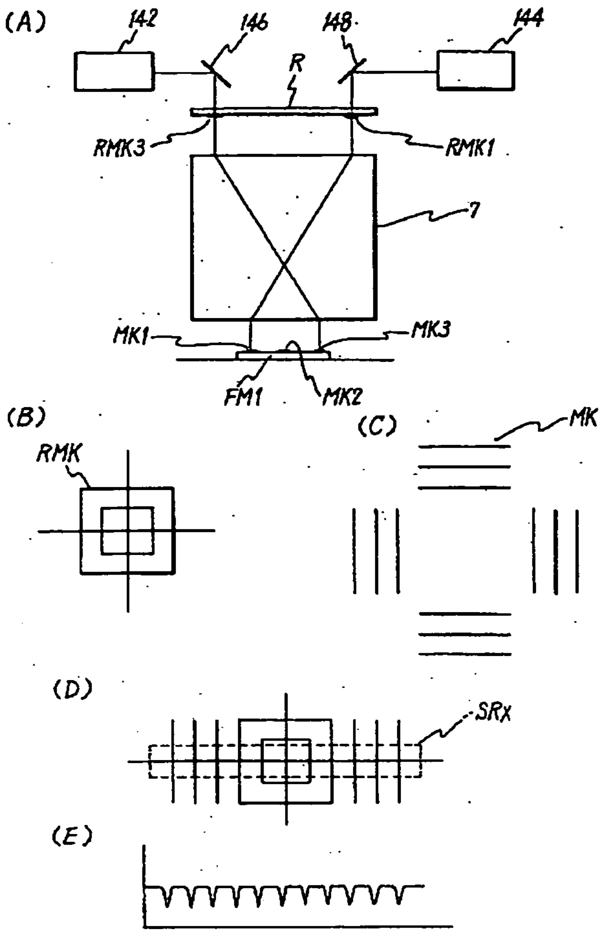
(B)



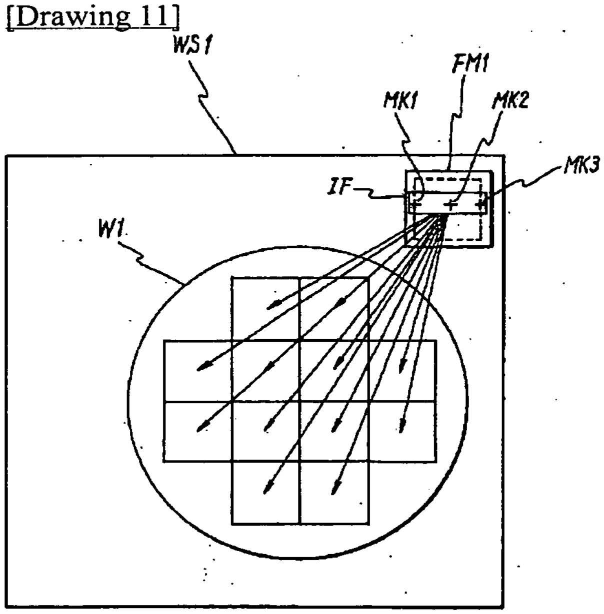
(C)



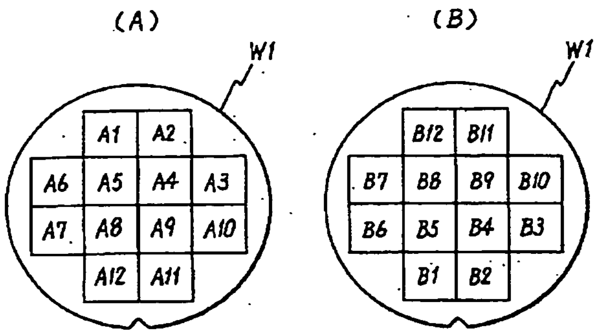
[Drawing 10]



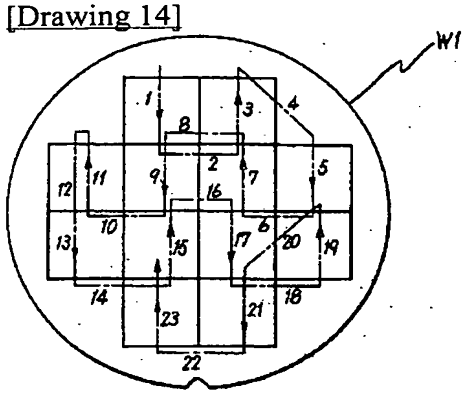
[Drawing 11]



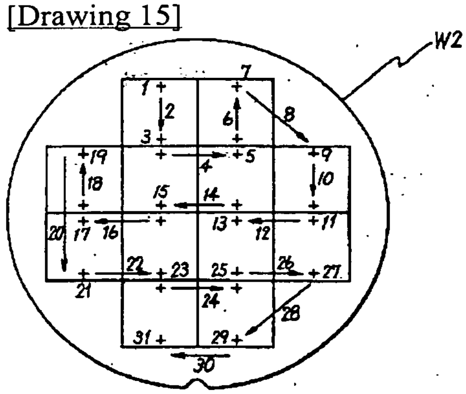
[Drawing 13]



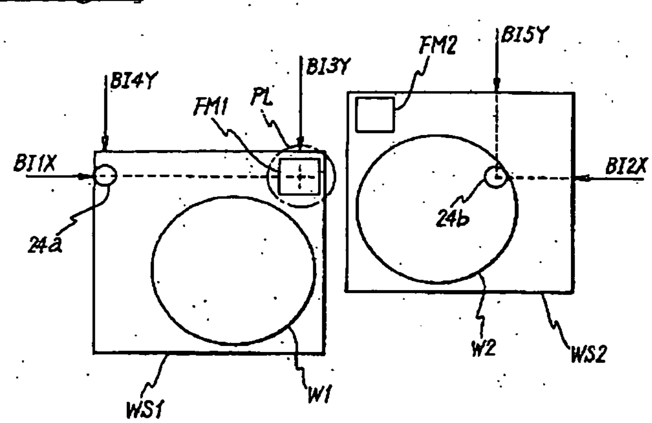
[Drawing 14]



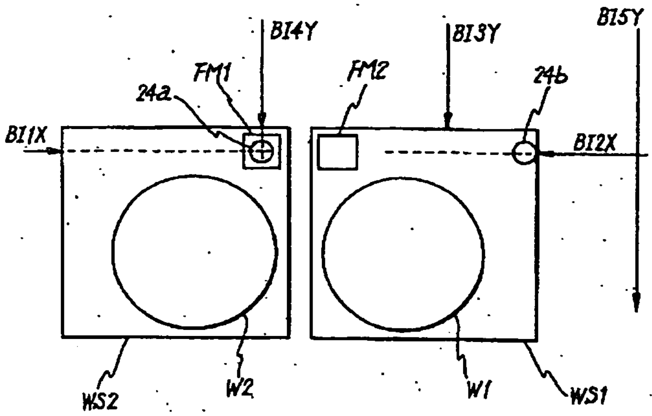
[Drawing 15]



[Drawing 16]



[Drawing 17]



[Translation done.]

CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
[Section partition] The 2nd partition of the 7th section
[Publication date] August 11, Heisei 17 (2005. 8.11)

[Publication No.] JP,10-214783,A
[Date of Publication] August 11, Heisei 10 (1998. 8.11)
[Application number] Japanese Patent Application No. 9-343740
[The 7th edition of International Patent Classification]

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H01L 21/027
G03F  7/20
G03F  9/00
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[FI]

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H01L 21/30     525 E
G03F  7/20     521
G03F  9/00         H
H01L 21/30     516 B
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[Procedure revision]
[Filing Date] January 19, Heisei 17 (2005. 1.19)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[The contents of amendment]
[Claim(s)]
[Claim 1]
It is the projection aligner which carries out projection exposure of the image of the pattern formed in the mask on an induction substrate through projection optics,
An induction substrate is held and it is the movable 1st substrate stage about the inside of a two-dimensional flat surface.;
Holding an induction substrate, said 1st substrate stage is the independently movable 2nd substrate stage about the inside of the same flat surface as said 1st substrate stage.;
Alignment system for detecting the mark on the induction substrate which was formed apart from said projection optics and held on said substrate stage or on said substrate stage;
The 1st length measurement shaft which always measures the location of said 1st shaft orientations of said 1st substrate stage from the one side of the 1st shaft orientations passing through the projection core of said projection optics, and the detection core of said alignment system, The 2nd length measurement shaft which always measures the location of said 1st shaft orientations of said 2nd substrate stage from the other side of said 1st shaft orientations, Interferometer systems which are equipped with the 3rd length measurement shaft which intersects said 1st shaft and perpendicular

focusing on projection of said projection optics, and the 4th length measurement shaft which intersects said 1st shaft and perpendicular focusing on detection of said alignment system, and measure the two-dimensional location of said 1st and 2nd substrate stage with these length measurement shafts, respectively;
While the induction substrate which the location of one stage of said 1st substrate stage and the 2nd substrate stages was managed using the measurement value of said 3rd length measurement shaft of said interferometer systems, and was held on one [this] stage is exposed The physical relationship of the alignment mark on the induction substrate held on the stage of another side of said 1st substrate stage and the 2nd substrate stages and the reference point on the stage of said another side the detection result of said alignment system, and the measurement value of the 4th length measurement shaft of said interferometer systems After controlling actuation of said two substrate stages to be used and detected, while using the measurement value of said 3rd length measurement shaft and resetting the interferometer of said 3rd length measurement shaft in the condition in which location measurement of the stage of said another side is possible Control means which controls actuation of the stage of said another side so that the origin/datum on the stage of said another side is positioned in the location which can detect physical relationship with the predetermined origin/datum in the projection field of said projection optics;
The projection aligner which ****.
[Claim 2]
It has another alignment system which has a detection core on said 1st shaft in the opposite side of said alignment system about said projection optics,
Said interferometer systems are equipped with the 5th length measurement shaft which intersects said 1st shaft and perpendicular focusing on detection of said another alignment system,
While the induction substrate which the location of one [said] stage was managed using the measurement value of said 3rd length measurement shaft of said interferometer systems, and was held on one [this] stage is exposed, said control means After controlling actuation of said two substrate stages so that the physical relationship of the alignment mark on the induction substrate held on the stage of said another side and the reference point on the stage of said another side is detected using the detection result of said alignment system, and the measurement value of the 4th length measurement shaft of said interferometer systems While resetting the interferometer of said 5th length measurement shaft in the condition in which location measurement of one [said] stage is possible using the measurement value of said 5th length measurement shaft The projection aligner according to claim 1 characterized by controlling actuation of one [said] stage so that the origin/datum on one [said] substrate stage is positioned in the detection field of said another alignment system.
[Claim 3]
It has further the carrier system which delivers an induction substrate between said 1st substrate stage and said 2nd substrate stage,
Said control means is a projection aligner according to claim 2 characterized by being in the condition which positioned the origin/datum on one [said] substrate stage, and delivering a substrate between one [said] stage and said carrier system in the detection field of said another alignment system.
[Claim 4]
On said 1st substrate stage and said 2nd substrate stage, the reference mark as a reference point of said stage is formed, respectively,
The predetermined reference point in the projection field of said projection optics is based on projection of the pattern image of said mask,
The projection aligner according to claim 1 characterized by having further a mark location detection means to detect the relative-position relation between the projection core of the pattern image of said mask, and the reference mark on said stage through said mask and said projection optics.
[Claim 5]
It is the projection exposure approach which carries out projection exposure of the image of the pattern of a mask on an induction substrate through projection optics,
An induction substrate is held and two independently movable substrate stages are respectively prepared for the inside of the same flat surface,

While a predetermined interferometer performs one location measurement of said two stages, projection exposure of the pattern image of said mask is carried out on the induction substrate held on one [this] stage,
While an interferometer other than said predetermined interferometer performs location measurement of the stage of another side of said two stages during exposure of the substrate held on one [said] stage, the physical relationship of the alignment mark on the substrate held on the stage of this another side and the reference point on the stage of said another side is measured,
While resetting said predetermined interferometer with said predetermined interferometer after exposure termination of the substrate held on one [said] stage in the condition in which location measurement of the stage of said another side is possible, the origin/datum of the stage of said another side is positioned in the location which can detect physical relationship with the predetermined origin/datum in the projection field of said projection optics,
The projection exposure approach characterized by performing alignment of the induction substrate and the pattern image of a mask which were held on the stage of said another side using said reset predetermined interferometer based on said measured physical relationship.
[Claim 6]
It is the projection aligner which carries out projection exposure of the image of the pattern formed in the mask on an induction substrate through projection optics,
An induction substrate is held and it is the movable 1st substrate stage about the inside of a two-dimensional flat surface.;
Holding an induction substrate, said 1st substrate stage is the independently movable 2nd substrate stage about the inside of the same flat surface as said 1st substrate stage.;
Alignment system for detecting the mark on the induction substrate which was formed apart from said projection optics and held on the reference mark and said substrate stage on said substrate stage;

The 1st length measurement shaft for measuring the location of said 1st shaft orientations of said 1st substrate stage from the one side of the 1st shaft orientations passing through the projection core of said projection optics, and the detection core of said alignment system, The 2nd length measurement shaft for measuring the location of said 1st shaft orientations of said 2nd substrate stage from the other side of said 1st shaft orientations, Interferometer systems which are equipped with the 3rd length measurement shaft which intersects perpendicularly with said 1st shaft focusing on projection of said projection optics, and the 4th length measurement shaft which intersects perpendicularly with said 1st shaft focusing on detection of said alignment system, and measure the two-dimensional location of said 1st and 2nd substrate stage with these length measurement shafts, respectively;
While exposing the induction substrate on one [this] stage, managing the location of one stage of said 1st substrate stage and said 2nd substrate stages using the 3rd length measurement shaft of said interferometer systems While searching for the physical relationship of the mark on the induction substrate held on the stage of said another side, and the reference mark on the stage of said another side using said alignment system, managing the location of the stage of said another side using the 4th length measurement shaft of said interferometer systems Control means which searches for the physical relationship of the projection location of the pattern image of said mask by said projection optics, and the reference mark on the stage of said another side, using said 3rd length measurement shaft and managing the location of the stage of said another side after exposure of the induction substrate held on one [said] stage;
The projection aligner characterized by ****(ing).
[Claim 7]
The projection aligner according to claim 6 which is after exposure of the induction substrate held on one [said] stage, and is characterized by resetting the measurement value of the 3rd length measurement shaft of said interferometer systems when searching for the physical relationship of the projection location of the pattern image of said mask by said projection optics, and the reference mark on the stage of said another side.
[Claim 8]
the physical relationship of the mark on the induction substrate with which said control means was held on the stage of said another side, and the reference mark on the stage of the another side -- and When the physical relationship of the projection location of the pattern image of said mask by said

projection optics and the reference mark on the stage of said another side is searched for The projection aligner according to claim 6 characterized by exposing the induction substrate held on the stage of said another side while controlling the location of the stage of said another side based on the measurement result of the 3rd length measurement shaft of ******.

[Claim 9]

Said control means is a projection aligner according to claim 8 characterized by positioning the stage of said another side and exchanging an induction substrate after exposure of the induction substrate held on the stage of said another side so that the reference mark on the stage of said another side may enter in the detection field of said alignment system.

[Claim 10]

The projection aligner according to claim 9 characterized by resetting the measurement value of the 4th length measurement shaft of said interferometer systems when detecting the reference mark on the stage of said another side by said alignment system.

[Claim 11]

It is the projection aligner which carries out projection exposure of the image of the pattern formed in the mask on an induction substrate through projection optics,

An induction substrate is held and it is the movable 1st substrate stage about the inside of a two-dimensional flat surface.;

Holding an induction substrate, said 1st substrate stage is the independently movable 2nd substrate stage about the inside of the same flat surface as said 1st substrate stage.;

Carrier system which delivers an induction substrate between said 1st substrate stage and said 2nd substrate stage;

Alignment system for detecting the mark on the substrate which was formed apart from said projection optics and held on the reference mark and said substrate stage on said substrate stage;

While one stage of said 1st substrate stages and said 2nd substrate stages performs delivery of said carrier system and induction substrate, it has the control means which controls said two substrate stages so that the stage of another side performs exposure actuation,

This control means is a projection aligner characterized by controlling one [said] stage so that the reference mark on one [said] stage enters in the detection field of said alignment system, when one [said] stage delivers an induction substrate between said carrier system.

[Claim 12]

It is the projection aligner which projects the image of a pattern on an induction substrate and exposes this induction substrate,

It has a reflector for interferometers, an induction substrate is held, and it is the 1st stage movable in the two-dimensional direction.;

It has a reflector for interferometers, an induction substrate is held, and said 1st stage is the 2nd stage movable in the two-dimensional direction independently.;

The 1st alignment system for searching for the 1st physical relationship of the criteria arranged on said stage, and the shot field on the induction substrate held on this stage;

Projection optics for separating to the 1st shaft orientations, being arranged to said 1st alignment system, and projecting said pattern image on an induction substrate;

The 2nd alignment system for searching for the 2nd physical relationship with the criteria arranged on the projection location and said stage of said pattern image by said projection optics;

In order to search for said 1st physical relationship, when alignment actuation which uses said 1st alignment system and performs mark detection of the induction substrate on one stage is performed, the location of said 1st shaft orientations of one [said] stage When exposure actuation which exposes the induction substrate on the stage of another side using the 1st length measurement shaft for measuring from the 1 side of said 1st shaft orientations and said projection optics is performed, the location of said 1st shaft orientations of the stage of said another side It is arranged possible [measurement of the location of the 2nd length measurement shaft for measuring from a side besides said 1st shaft orientations, and the 2nd shaft orientations perpendicular to said 1st shaft orientations of the stage of said another side where exposure actuation to said induction substrate is performed].

The 3rd length measurement shaft which separates from the reflector of the stage of said another side after termination of said exposure actuation, In parallel to said exposure actuation, it is arranged possible [measurement of the location of said 2nd shaft orientations of one / said / stage where

alignment actuation to said induction substrate is performed]. It has the interferometer systems and; which have the 4th length measurement shaft which separates from the reflector of one [said] stage after termination of said alignment actuation,
The mark on the induction substrate is detected between the alignment actuation to said induction substrate on one [said] stage, and the 1st physical relationship of the shot field on the induction substrate concerned and the criteria arranged on one [said] stage is searched for,
The 2nd physical relationship of the projection location of said pattern image by said projection optics and the criteria of one [said] stage is searched for using said 2nd alignment system after termination of said alignment actuation by the side of one [said] stage, and said exposure actuation by the side of the stage of said another side,
The projection aligner with which sequential exposure of the shot field on the induction substrate held on one [said] stage is carried out while controlling the location of one [said] stage based on said 1st physical relationship and said 2nd physical relationship, after said 2nd physical relationship is searched for.
[Claim 13]
It is the projection aligner according to claim 12 with which the location of one [said] stage is measured using the 2nd length measurement shaft of said interferometer systems when searching for the 2nd physical relationship of the projection location of said pattern image by said projection optics, and the criteria of one [said] stage using said 2nd alignment system.
[Claim 14]
It has a base member further,
Said 1st and 2nd stages are projection aligners given in any 1 term of claims 12-14 independently movable in the two-dimensional direction on said base member, respectively.
[Claim 15]
A projection aligner given in any 1 term of claims 12-14 by which said 1st stage and said 2nd stage are moved by turns to the image surface side of said projection optics, and sequential exposure of two or more induction substrates is carried out.
[Claim 16]
The criteria arranged on one [said] stage have the 1st reference mark and the 2nd reference mark,
Said 1st physical relationship is searched for by detecting the mark and said 1st reference mark on the induction substrate on one [said] stage using said 1st alignment system, measuring the location of one [said] stage using said 1st length measurement shaft,
Said 2nd physical relationship is searched for by detecting the physical relationship of said 2nd reference mark and the mark of the mask with which said pattern was formed through said projection optics using said 2nd alignment system, measuring the location of one [said] stage using said 2nd length measurement shaft,
A projection aligner given in any 1 term of claims 12-15 by which the shot field on the induction substrate with which the physical relationship of the projection location of the pattern image by said projection optics and the shot field on the induction substrate held on one [said] stage was determined, and was held on one [said] stage based on the this determined physical relationship based on said 1st physical relationship and said 2nd physical relationship is exposed.
[Claim 17]
It has further the substrate carrier system which conveys an induction substrate,
In advance of said alignment actuation, delivery of an induction substrate is performed between one [said] stage and said substrate carrier system in parallel to exposure actuation on the stage of said another side,
The projection aligner according to claim 16 to which detection of said 1st reference mark is performed by said 1st alignment system by the condition that said 1st length measurement shaft can measure the location of one [said] stage after performing delivery of said carrier system and induction substrate.
[Claim 18]
Said substrate carrier system is a projection aligner according to claim 17 which separates to said 1st shaft orientations and is arranged to said projection optics.
[Procedure amendment 2]
[Document to be Amended] Specification

[Item(s) to be Amended] 0059
[Method of Amendment] Modification
[The contents of amendment]
[0059]
According to this, actuation of both stages is controlled so that the stage of another side performs exposure actuation by the control means, while one stage of the 1st substrate stage and the 2nd substrate stages delivers an induction substrate between carrier system. Therefore, parallel processing of actuation of the time amount T1 explained previously and the actuation of time amount T four can be carried out. Moreover, a control means can perform the location measurement of a reference mark and the exchange of an induction substrate which are alignment initiation actuation since a stage is controlled so that the reference mark on one stage enters in the detection field of an alignment system in while when one stage delivers an induction substrate between carrier system by the quiescent state of a substrate stage. Furthermore, it becomes possible to perform actuation of the time amount T1, the time amount T2, and time amount T3 which were explained previously by one substrate stage side in addition to the transit time of the substrate stage from a substrate exchange location to an alignment starting position serving as zero, and to operate time amount T four by the substrate stage side of another side. Therefore, it becomes possible to raise a throughput compared with the conventional sequential processing in which time amount (T1+T2+T3+T four) was required.
Moreover, it is the projection aligner which this invention projects the image of a pattern on an induction substrate, and exposes this induction substrate. Have a reflector for interferometers (21) and hold an induction substrate (Wl), and have the 1st movable stage (WSl) and a reflector for; interferometers (23) in the two-dimensional direction (X shaft orientations, Y shaft orientations), and an induction substrate (W2) is held. The criteria independently arranged with the 1st stage (WSl) on the 2nd stage (WS2) movable in the two-dimensional direction (X shaft orientations, Y shaft orientations), and; stage (WSl or WS2) (MK2), To the 1st alignment system (24a) and the; 1st alignment system (24a) for searching for the 1st physical relationship with the shot field on the induction substrate held on this stage, separate to the 1st shaft orientations (X shaft orientations), and it is arranged. In order to search for the 2nd alignment system (142), and the; 1st physical relationship for searching for the 2nd physical relationship with the criteria (MKl) arranged on the projection location and stage of a pattern image by the projection optics (PL) and; projection optics (PL) for projecting a pattern image on an induction substrate When alignment actuation which performs mark detection on the induction substrate on one stage (for example, Wl) using the 1st ally noodle ** system (24a) is performed, the location of the 1st shaft orientations (X shaft orientations) of one stage (WSl) The 1st length measurement shaft for measuring from the 1 side of the 1st shaft orientations (X shaft orientations) (BI1X), When exposure actuation which exposes the induction substrate on the stage of another side (W2) using projection optics (PL) is performed, the location of the 1st shaft orientations (X shaft orientations) of the stage (WS2) of another side The 2nd length measurement shaft for measuring from a side besides the 1st shaft orientations (X shaft orientations) (BI2X), It is arranged possible [measurement of the location of the 2nd shaft orientations (Y shaft orientations) perpendicular to the 1st shaft orientations (X shaft orientations) of the stage (WS2) of another side where exposure actuation to an induction substrate is performed]. The 3rd length measurement shaft which separates from the reflector (23) of the stage (WS2) of another side after termination of exposure actuation (BI3Y), In parallel to exposure actuation, while is performed and the alignment actuation to an induction substrate is arranged possible [measurement of the location of the 2nd shaft orientations (Y shaft orientations) of a stage (WSl)]. It has the interferometer systems and; which have the 4th length measurement shaft (BI4Y) which separates from the reflector (21) of one stage (WSl) after termination of alignment actuation. Between the alignment actuation to the induction substrate (Wl) on one stage (WSl) Detect the mark on the induction substrate (Wl), and the 1st physical relationship of the shot field on the induction substrate (Wl) concerned and the criteria (MK2) arranged on one stage (WSl) is searched for. After termination of the alignment actuation by the side of one stage (WSl), and the exposure actuation by the side of the stage (WS2) of another side The 2nd physical relationship of the projection location of a pattern image and the criteria (MKl) of one stage (WSl) by projection optics (PL) is searched for using the 2nd alignment system (142). It is characterized by carrying out sequential exposure of the shot field on the

induction substrate (W1) held on one stage (WSl), controlling the location of one stage (WS1) based on the 1st physical relationship and 2nd physical relationship, after the 2nd physical relationship is searched for.
Since according to this it becomes possible to raise a throughput and a stage reflector can be made small, the miniaturization of a stage can be attained.

[Translation done.]